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Workflow Service Administration Guide

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Contents

About this Book and the Library	9
Part I Introduction to Workflow Service	11
1 Introduction to the Workflow Service Components	13
Workflow Administration Console.....	13
Form Builder.....	13
Workflow Builder.....	14
Workflow Engine.....	14
Workflow Database.....	15
2 Understanding Authorizations in Workflow Service	17
Part II Getting Started with Workflow Administration Console	19
3 Exploring the Dashboard	21
Understanding Dashboard Tiles.....	21
4 Configuring Default Settings for Workflow Administration Console	23
Manage User Access.....	23
Assigning Trustees.....	23
Configure Advanced Settings.....	24
Add a New Configuration Property.....	24
Edit Existing Configuration Properties.....	25
Add Category and Process Type to the Workflow Catalog.....	25
Add a Category or Process Type.....	25
Delete a Category.....	26
Customize the User Interface Display Settings.....	26
General Settings.....	26
Dashboard Settings.....	26
Column Customization Settings.....	27
Part III Working with Forms Catalog	29
5 Forms Catalog Overview	31
About Forms.....	31
About Request Forms.....	31
About Approval Forms.....	31
About Template Forms.....	32
About Form Builder.....	32

6	Managing Forms in Forms Catalog	33
	Listing Forms	33
	Finding a Form	33
	Sorting the List by Columns	34
	Customizing the Columns	34
	Form Legends	34
	Creating New Forms	35
	Creating New Request, Approval, or Template Form	35
	Creating a New Form by Copying an Existing Form	36
	Creating a New Form from Template Forms	36
	Exporting and Importing Forms	37
	Form Actions	37
	Restoring Previous Version of a Form	38
	Modifying a Published Form	38
	Deleting Forms	39
	Part IV Working with Workflow Catalog	41
	7 Workflow Catalog Overview	43
	8 Managing Workflows in a Catalog	45
	Creating a Workflow	45
	Copying a Workflow	46
	Editing a Workflow	46
	Editing Properties on the Overview Tab	46
	Exporting and Importing Workflows	48
	Deleting a Workflow	48
	Restoring a Workflow	49
	Publishing a Workflow	49
	Viewing Workflow Association	49
	Listing Workflows	49
	Sorting Workflows	49
	Searching for a Workflow	50
	Customizing Columns	50
	Using the System Templates for Workflows	51
	Part V Workflow Builder Overview	53
	9 Using Workflow Builder to Create Workflows	55
	About Workflow Builder	55
	Canvas	55
	Palette	56
	Associated Views	56
	Adding Activities to a Workflow	57
	Setting the General Properties of an Activity	58
	Defining the Data Items for an Activity	58
	Defining the Email Template Settings	59
	Validating a Workflow	60
	Adding Flow Paths	60

Configuring Flow Paths	60
Guidelines for Creating Workflows	62
Rules for Activities	62
Rules for Flow Paths	62
Understanding Workflow Data	64
Debugging a Workflow	67
Using the Log Activity	67
Changing Log Levels.	67

10 Workflow Activity Reference 69

Start Activity	69
Properties	69
Data Items	70
Email Template.	71
Problems.	72
Finish Activity	72
Properties	72
Data Items	72
Email Template.	72
Problems.	74
Approval Activity	75
Properties	75
Data Items	80
Available ECMAScript Methods	81
Email Template.	82
Specifying the Addressee Property	84
Problems.	89
Log Activity	89
Properties	89
Data Items	90
Email Template.	90
Problems.	90
Condition Activity	91
Properties	91
Data Items	92
Email Template.	92
Problems.	92
Mapping Activity	92
Properties	93
Data Items	93
Email Template.	93
Problems.	94
Workflow Status	94
Properties	94
Data Items	94
Email Template.	94
Problems.	94
Email Activity.	95
Properties	95
Data Items	95
Email Template.	95
Problems.	96
Rest Activity.	97

Properties	97
Data Items	101
Email Template	101
Problems	101
Notify Activity	101
Properties	102
Data Items	102
Email Template	102
Problems	103
Integration Activity	103
Properties	103
Data Items	104
Email Template	105
Problems	105
Working with Integration Activities	105
Adding an Integration Activity	106
Moving Data to and from the Integration Activity	107
Adding a Web Service Authentication Certificate to Workflow Service	108
Troubleshooting Issues with Integration Activity	109
Subprocess Activity	110
Branch Activity	111
Merge Activity	112
11 Working with ECMA Expressions	113
About the ECMA Expression Builder	113
About ECMAScript	113
Using the ECMA Expression Builder	114
About Global Configuration Values Integration	114
Part VI Working with Email Notification Templates	115
12 Email Notification Template Overview	117
13 Setting Up Email Notification Templates	119
Creating Templates	119
Creating a New Notification Template	119
Inserting a Token	120
Editing a Notification Template	121
Deleting Notification Templates	121
Managing Notification Templates	121
Sorting Templates	121
Searching for a Template	121
Customizing Columns	122
Importing and Exporting Templates	122
Using System-Defined Templates	123
Exporting and Importing Templates for Localization	123
Deleting Localized Templates	124
Publishing Templates	124

Part VII Working with Email Based Approval	127
14 Email-Based Approval Overview	129
15 Managing Approvals by Email	131
Checklist to Setup Email-Based Approval	131
Choosing Email-Based Approval Templates for Workflow	132
Enabling Email-Based Approval on Cluster Environment	132
Configuring Outgoing Email Settings	133
Enabling Email Approval and Configuring Incoming Mail Server Properties	135
Troubleshooting Email-Based Approval Issues	137
Part VIII Configuring Default Settings for Workflow Engine and Cluster	141
How Clustering Works?	141
16 Configuring Workflow Engine and Cluster Settings	143
Configuring the Workflow Engine Settings	143
Configuring the Workflow Cluster Settings	145
Reviewing the Status of Workflow Engines	145
Deleting an Instance of Workflow Engine	146
Part IX Understanding Workflow Monitoring	147
17 Monitoring Workflow Processes	149
Finding Workflow Processes That Match Search Criteria	149
Sorting Workflow Processes by Recipient, Requester, or Request Date	150
Customizing the Columns	150
Viewing the Status of a Workflow Process	150
Viewing the Approval Status of a Workflow Process	151
Actions You Can Perform On The Page	152
Terminating a Workflow Process	152
Reassigning a Workflow Process	153
Viewing Workflow Process Comments	153
Part X Understanding and Setting Up Event Logging	155
18 Understanding the Basics of Logging	157
About Logging Services	157
What Can Be Logged	162
The Workflow Logging Environment and Process	162
Terminology	162
Components for Logging	163
How Logging Works	163
Types of Log Files	164
Catalina Log	164
Localhost Log	164

Application Log	164
Additional Log Files	165
Understanding the Log Format	165
Message Fields	166
Message Severity	167
19 Configuring Logging	169
Configuring Logging	169
Understanding Logging Configuration	169
Understanding the Log Level Settings	170
Specifying the Severity Level for Commons Logging API Loggers	170
Editing the Logging Configuration File	171
Managing Log File Size	171
Changing the Log Levels for Features	172
Adding a Package	172
20 Configuring Logging in a Cluster	175
Tomcat Logging	175
Workflow Logging	176
Part XI Understanding Audit Configuration	177
21 Configure Audit Events Overview	179
22 Configuring Audit Events	181
Enabling and Disabling the Audit Configuration	181

About this Book and the Library

The *Administration Guide* describes how an administrator can utilize the Workflow Administration Console to manage, design, and monitor different workflows used for provisioning and fulfillment of resources.

Intended Audience

This book provides information for administrators who are responsible for designing, managing, and monitoring workflows.

Introduction to Workflow Service

Workflow Service is a web-based service for creating workflows. It allows you to create, execute, and manage workflows, ranging from simple approval processes to custom workflows that exchange data with REST services. As a result, workflows created using Workflow Service can integrate with other systems both inside and outside the organization. For example, Identity Governance employs Workflow Service to build custom approval processes. The approval process is then associated with the permissions. When a user requests for permission, the Workflow Service initiates and executes the approval process.

Workflow Service provides a wide range of capabilities, including:

Designing Workflows

Design workflows using custom request and approval forms.

Monitoring and Managing Workflow Processes

Initiate a workflow and monitor the running workflow process.

Email Based Approval

Request reviewers to approve or deny a request using email.

Email Notification Service

Notify approvers of tasks in their queues, inform the initiator that the workflow is done, or update if there is any change in the workflow status.

Logging

Debug the configurations for various features provided in the applications.

Auditing

Log events occurring in the Workflow Administration Console to provide evidence that you are complying with regulations.

1 Introduction to the Workflow Service Components

The Workflow Service rely on a number of components acting together:

- ♦ [“Workflow Administration Console” on page 13](#)
- ♦ [“Workflow Engine” on page 14](#)
- ♦ [“Workflow Database” on page 15](#)

Workflow Administration Console

Workflow Administration Console integrates the Workflow Builder and Form Builder, which add workflow and form-building capabilities to the application, respectively.

Form Builder

Form Builder is a web-based service used for designing forms. It is a platform for application developers and administrators to build their own complex forms. It combines JavaScript forms with REST API Data Management platforms to set up form-based progressive web applications.

Form Builder provides the following features and benefits:

- ♦ Drag and drop feature that enables you to quickly create modern and responsive forms
- ♦ Multiple components (widgets) with modern look and feel
- ♦ Simplify connections between the forms and the REST APIs
- ♦ Integrated with the JavaScript Editor to provide a consolidated view of all the JavaScript methods in the form
- ♦ Integrated with the JSON Editor to edit JSON forms directly
- ♦ Support for inbuilt localization for forms
- ♦ Allows you to search and read the REST API description and invoke the REST API in JS methods with a single click. Automatically populates the code in JavaScript Editor to call the API

For more information about the Form Builder, see [Administrator’s Guide to the Form Builder](#).

About Form Control Data Binding

Every field that you add in a form using Form Builder is automatically available for data binding when you associate that form with a workflow. The Data Binding includes the following types of binding or mapping for a field:

- ♦ A pre-activity mapping to initialize or pre-load a form field with data
- ♦ A post-activity mapping to move modified form data into the workflow document. This process is called flowdata

The **Data Items** tab in the workflow builder displays this mapping property sheet. The data item mappings, along with any script expressions that are used, are executed in the Workflow Engine before the form is displayed to the end user. Common uses for pre-activity data-item mappings and their expressions that operate against the flow-data document are for moving previous approval data into the current approval or for setting default values for fields. For more information on data item mappings, see [“Defining the Data Items for an Activity” on page 58](#).

Workflow Builder

Workflow Builder is a component of the Workflow Administration Console that allows you to build workflows. It provides an array of activities that you can use to create workflow diagrams based on the consumer application business requirement. Forms created in Form Builder are available for associating with the workflow activities in Workflow Builder.

Workflow Builder user interface is intuitive and easy to use. To create a simple workflow diagram, drag-and-drop activities to the canvas, attach request and approval forms to the activities, connect with the global connect tool. For more information on how to use Workflow Builder, see [Chapter 9, “Using Workflow Builder to Create Workflows,” on page 55](#).

The workflow database maintains workflows in XML format. Until the workflow is published, the XML is saved in an intermediate state. After publishing, it is ready for use in the consumer application. Workflow Builder communicates with the workflow runtime database via REST API that enables you to create, read, update, and delete workflows.

Workflow Builder is built on [BPMN.iO](#), an open-source project for the modeling framework and toolkits. Refer to the [bpmn.io License](#) for details that governs the usage of this toolkit.

Workflow Engine

The Workflow Engine is responsible for managing and executing steps in an administrator-defined workflow and keeping track of state information. The Workflow Engine persists the information in the workflow runtime database.

The Workflow Engine supports features such as email based approval and email notification. During the course of workflow execution, the Workflow Engine can send one or more email messages to notify users of changes in the state of the workflow. You can edit an email template and use this

template for email notifications. At runtime, the Workflow Engine retrieves the template from the database and replaces tags with dynamic text suitable for the notification. For more information, see [Chapter 13, “Setting Up Email Notification Templates,” on page 119](#).

In addition, the Workflow Engine also provides functionalities such as logging, generating reminder and escalation notifications, retrying failed processes, and heartbeat monitoring. The Workflow Engine gathers workflow metrics and lets you monitor an approval flow process. The Workflow Engine can also be clustered in your deployment to overcome the fail-over scenario and to manage the workload.

Workflow Database

Workflow Service uses the workflow runtime database to store the following information:

- ◆ Configuration data for the application, such as Web page definitions and preference values
- ◆ Workflow definitions, forms, and email templates
- ◆ The state information of active and completed workflow processes
- ◆ Global configurations and page access settings

2 Understanding Authorizations in Workflow Service

Workflow Service relies on predefined authorizations (set of permissions) to provide access to users or groups. The authorizations for administrators are assigned in the application that integrates with Workflow Service. For example, users or groups with Identity Governance Global, Customer, or Access Request authorization will be the Workflow Administrator when Workflow Service is integrated with Identity Governance. For more information about Identity Governance authorizations, see [Identity Governance User and Administration Guide](#).

You must be assigned one of the following authorizations to perform operations on the Workflow Administration Console:

Table 2-1 Workflow Service authorizations

Permissions	For SaaS Deployment	For On-premises Deployment
View the Dashboard and About pages	All authenticated users	All authenticated users
Create and manage forms using the Form Builder	Workflow Administrator	Workflow Administrator
Create and manage workflows using the Workflow Builder	Workflow Administrator	Workflow Administrator
Create and manage templates used for email notifications	Workflow Administrator	Workflow Administrator
Monitor the status and comments for workflow processes	Workflow Administrator	Workflow Administrator
Reassign tasks to other users	Workflow Administrator	Workflow Administrator
Grant or revoke access to the Workflow Administration Console pages	<ul style="list-style-type: none"> ◆ Workflow Administrator ◆ Customer Administrator* 	Workflow Administrator
Customize the Dashboard and other user interface display properties	<ul style="list-style-type: none"> ◆ Workflow Administrator ◆ Customer Administrator 	Workflow Administrator
Add new or modify existing configuration properties in the workflow runtime database	SaaS Operations Administrator**	Workflow Administrator
Export and import workflows and forms from one environment to another	<ul style="list-style-type: none"> ◆ Workflow Administrator ◆ Customer Administrator 	Workflow Administrator
Configure the incoming and outgoing email server settings to notify users of tasks that are triggered when a workflow is executed	SaaS Operations Administrator	Workflow Administrator

Permissions	For SaaS Deployment	For On-premises Deployment
Customize the Workflow Engine's default settings and cluster configurations to meet an organization's needs	SaaS Operations Administrator	Workflow Administrator
Change the log levels to support application debugging. This helps to identify and isolate problems caused by configuration errors, invalid user data, or issues related to workflow execution	SaaS Operations Administrator	Workflow Administrator
Enable or disable event logging to the preferred auditing services	SaaS Operations Administrator	Workflow Administrator
* A customer administrator oversees the configuration of a single tenant, such as assigning authorizations or roles to specific users within that company.		
** A SaaS operations administrator is a member of the SaaS team who is responsible for customer tenancy operations.		

IMPORTANT: The above authorizations and their associated permissions cannot be modified in the Workflow Administration Console. You can, however, assign users or groups as trustees and enable them to perform operations such as editing workflows. For more information about trustees, see [“Manage User Access” on page 23](#).

|| Getting Started with Workflow Administration Console

This section tells you how to begin using the Workflow Administration Console. Topics include:

- ◆ [Chapter 3, “Exploring the Dashboard,” on page 21](#)
- ◆ [Chapter 4, “Configuring Default Settings for Workflow Administration Console,” on page 23](#)

3 Exploring the Dashboard

With an increasing number of workflows, being able to generate an easy-to-understand summary is crucial, especially if you are in the role of an administrator. The Dashboard provides easy-to-read, easy access, real-time information that you need to know about the approval flow process and make informed decisions without having to install a separate web service for gathering workflow metrics.

The Dashboard is the default landing page that displays when you log in to the Workflow Administration Console for the first time. The Dashboard provides you a summary of all workflow processes in the database derived using simple metrics for analyzing the workflow performance. Each metric is represented on the Dashboard in form of a tile. You can monitor these tiles to keep track of how the workflow processes are performing. For example, you can monitor the number of workflow processes that are pending approval or the number of workflow processes retracted or reassigned to another user. It helps you to prioritize the workflows based on the need of your organization.

Understanding Dashboard Tiles

You will find six different tiles pinned to the Dashboard. Each tile provides you a consolidated summary of workflow processes and the associated activities.

PENDING APPROVALS

This tile gives you the number of activities that are pending approval. The activities are listed in reverse chronological order, which means the most recent activity that was sent (and pending) for approval is listed at the top. For each activity, the tile also displays the time passed since it got assigned to the recipient. These activities have the status “Processing” in the database, indicating that they are awaiting approval from the approver.

CURRENT REASSIGNMENTS

This tile gives you the number of activities reassigned from the original approver to a new approver. The activities are listed in reverse chronological order, which means the most recently reassigned activity is listed at the top. The tile also displays the names of the original and new approvers of the activity. These activities have the status “Processing” in the database, indicating that they are awaiting approval from the new approver.

RETRACTION REQUESTED

This tile gives you the number of workflow processes that were retracted by the requester before the workflow completion. The activities are listed in reverse chronological order, which means the most recently retracted request is listed at the top. For each workflow process, the tile also displays the time passed since the request got retracted. These processes are marked as “Terminated” in the database.

LONG WAITING APPROVAL

This tile gives you the number of activities that are pending approval for a long duration. The duration is determined by the value you provide on the Dashboard Settings page. By default, the value is set to 3 days. For more information, see [“Dashboard Settings” on page 26](#).

The activities are listed in reverse chronological order, which means the longest pending approval activity in the database is listed at the top. For each activity, the tile also displays the time passed since the activity got assigned to the recipient.

LONG EXECUTED PROCESSES

This tile gives you the number of workflow processes that took the longest duration for completion. The duration is determined by the value you provide on the Dashboard Settings page. By default, the value is set to 3 days. For more information, see [“Dashboard Settings” on page 26](#).

The processes are listed in reverse chronological order, which means the process that took the longest time for completion is listed at the top. For each process, the tile also displays the time passed since the process got completed.

NOTE: Only workflow processes that have been completed are counted.

LONG COMPLETED APPROVALS

This tile gives you the number of activities in the database approved after a long duration. The duration is determined by the value you provide on the Dashboard Settings page. By default, the value is set to 3 days. For more information, see [“Dashboard Settings” on page 26](#).

The activities are listed in reverse chronological order, which means the activity that took the longest time for completion is listed at the top. For each activity, the tile also displays the time passed since the activity got approved or denied.

NOTE: Only activities in approved and denied states are counted.

4 Configuring Default Settings for Workflow Administration Console

If you are a Workflow or Bootstrap Administrator, the Workflow Administration Console by default provides you an access to the Settings page. You have complete control over all configuration operations provided on this page. You can set trustees for each navigation item (including the Settings page), add or modify global configuration settings, and also customize the user interface display settings. For a detailed information on how to perform each of these operations, refer to the following sections:

- ♦ [“Manage User Access” on page 23](#)
- ♦ [“Configure Advanced Settings” on page 24](#)
- ♦ [“Add Category and Process Type to the Workflow Catalog” on page 25](#)
- ♦ [“Customize the User Interface Display Settings” on page 26](#)

IMPORTANT: If you are a user other than the Workflow or Bootstrap Administrator with access permission to the Settings page, you still may not be able to view or perform all operations available on this page. This happens when you are not added as trustee for all operations listed under the **Settings** navigation item. For more information, see [“Manage User Access” on page 23](#).

Manage User Access

The Settings page in the Workflow Administration Console allows you to control the accessibility and visibility of the pages for a user. You can add users and groups as trustees, which provides them access to different pages within the console. Trustees can view only the pages to which they have access.

Based on the policies of your organization, you can click **Access > Settings** to assign permissions to users, who in turn can act as administrators.

NOTE: A trustee who has access permission to the Settings page, cannot view the page unless he has permissions to one or more page items under **Access > Settings**.

The trustees can perform operations on the pages for which they have permission. However, if a trustee tries to access a page that is not provisioned, they are redirected to the dashboard.

Each Navigation item has a set of default trustees. If no default trustee is assigned, the **Add Trustee** link is displayed.

Assigning Trustees

You can assign access permissions to perform tasks such as create, edit, delete, reassign, restore.

To configure a trustee for a page:

- 1 In the Workflow Administration Console, select **Settings > Access**.
- 2 Expand the required Navigation item for which you want to provision access.

NOTE: When you provide access to a page item, you must provide access for the Navigation item of that page.

- 3 Click the link under the Trustees column.
- 4 Click the **Select User, Group** box, and select the relevant tab.
- 5 Use the search field to search for users or groups.
- 6 Specify one or more trustees for the selected page item.
- 7 Click **Ok**.
- 8 Click **Save**.

Configure Advanced Settings

The **Advanced** settings enables you to make application level changes in the Workflow Administration Console. You can add new configuration properties or modify the existing properties directly to the workflow runtime database. The configuration property key and its values are stored in a central location so that multiple workflow engines can use the same setting values.

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the advanced settings.

Add a New Configuration Property

To add a new configuration property to the workflow runtime database, perform the following actions:

- 1 Click the **Advanced** drop-down menu on the Settings page.
- 2 Click the **Add new configuration** option.
- 3 In the NEW CONFIGURATION modal window, enter the **Key** for the configuration property that you want to add. Characters allowed includes A-Z, a-z, slash (/), hyphen (-), period (.), and underscore (_).
- 4 (Conditional) To enable encryption for the **Value** text box, select the **Encrypt** check box.
- 5 Enter a **Value** for the configuration property. Characters allowed includes A-Z, a-z, 0-9, and special characters. The input value will get encrypted if you have enabled encryption in [Step 4](#), else it will display in clear-text.

NOTE: The application does not consider any whitespace provided at the beginning or end of a value and saves the input without these characters. However, it does not apply if the value field is encrypted.

- 6 Click **Add**.

Edit Existing Configuration Properties

To modify any configuration property that is already present in the workflow runtime database, perform the following actions:

- 1 Click the **Advanced** drop-down menu on the Settings page.
- 2 You can search for the property by its key or value. The search finds every key or value that begins with the text you type. It is not case sensitive. You can optionally use the asterisk (*) as a wildcard in your text to represent zero or more of any character that you want to search.
- 3 Identify the property that you want to modify. Click the **Edit** icon corresponding to that property.
- 4 Change the value in the **Value** field as desired. Characters allowed includes A-Z, a-z, 0-9, and special characters.

NOTE: If the value is non-encrypted, the application does not consider any whitespace provided at the beginning or end of the value and saves the input without these characters.

- 5 (Optional) If you want to revert the field to its previous value, click the **Reset** icon.
- 6 Click the **Save** icon.

Add Category and Process Type to the Workflow Catalog

Category and process type are attributes that are used to organize workflows in the workflow catalog. They are used for filtering and sorting the workflow list on the Workflows page. By default, there are two categories namely `Accounts` and `System Templates` defined under the main category and one process type, that is `Normal`.

You can define any number of categories and process type that your organization might need using the **Add Category** and **Add Process Type** options provided under the **Settings > Workflow Catalog** option. For an example, you can add a category named `Roles` to contain all workflows related to role requests and a process type named `Role Approval` to define the workflow type as role approval.

When a user selects a workflow for editing on the Workflows page (**Catalog > Workflow**), these categories and process types are displayed in the **Category** and **Process Type** drop-down list in the **Overview** tab. The user can select the category under which they want put their workflow. For more information, see [“Editing a Workflow” on page 46](#).

Add a Category or Process Type

To add a category or process type, perform the following actions:

- 1 Click the **Workflow Catalog** drop-down menu on the Settings page.
- 2 (Conditional) If you want to add a new category, perform the following actions:
 - 2a Click the **Add Category** option next to the **Category** attribute.
 - 2b Enter a unique identifier in the **Key** field.
 - 2c Specify a name. The string is displayed in the **Category** drop-down list in the **Overview** tab when editing a workflow.

- 3 (Conditional) If you want to add a new process type, perform the following actions:
 - 3a Click the **Add Process Type** option next to the **Process Type** attribute.
 - 3b Enter a unique identifier in the **Key** field.
 - 3c Specify a name. The string is displayed in the **Process Type** drop-down list in the **Overview** tab when editing a workflow.
- 4 Click **Save**.

Delete a Category

To delete a category, select that category from the list, click the trash icon, then click **Confirm**.

Similarly, select the process type that you want to delete, click the trash icon, then click **Confirm**.

NOTE: You cannot delete a category or process type when they are associated with a workflow.

Customize the User Interface Display Settings

The following options under the **UI Display Settings** helps you to customize the display properties of the Workflow Administration Console:

- ♦ [“General Settings” on page 26](#)
- ♦ [“Dashboard Settings” on page 26](#)
- ♦ [“Column Customization Settings” on page 27](#)

General Settings

The parameters in the **General** tab enables you to configure the default settings that applies to all pages in the Workflow Administration Console.

Specify the number of results to be displayed per page

Select a number from the list that you want to set in the pagination on all pages. It determines the maximum number of results that a page can display. Default value is 5, however you can set the value to 50 at maximum.

Feedback Message Span

Specifies the time span (in milliseconds) for which a feedback message will appear on a page. Default value is 10000 milliseconds (10 seconds).

Dashboard Settings

You can use the parameters in the **Dashboard** tab to change the default behavior of some tiles on the Dashboard page. This can be particularly useful in tracking workflow processes. For example, if you want to prioritize the workflow processes that are pending approval for more than 10 days, change the value for the **Number of days to consider for marking pending workflows as long-waiting approval**

parameter to 10. You can now monitor the processes pending approval in the LONG WAITING APPROVAL tile on the Dashboard page. For more information on such functionalities, review the following dashboard parameters and customize them as required:

Maximum number of workflows allowed to display on each tile

Applies to all tiles on the Dashboard page.

Specify how many workflow processes or activities are allowed to display on each tile at maximum. The valid range is between 5 and 10. If you specify the value as 5, the **Dashboard** displays the details of five most recent workflow process or activity.

Number of days to consider for marking pending workflows as long-waiting approval

Applies only to the LONG WAITING APPROVAL tile on the Dashboard.

Specify after how many days workflow activities in the processing state can be marked as long-waiting approval.

Number of days to consider for marking workflow processes as long-executed process

Applies only to the LONG EXECUTED PROCESSES tile on the Dashboard.

Specify how many days must be considered at minimum to mark workflow processes (in completed state) as long-executed processes.

Number of days to consider for marking approval activities as long-completed approvals

Applies only to the LONG COMPLETED APPROVALS tile on the Dashboard.

Specify how many days must be considered at minimum to mark approval activities (in approved state) as long-executed approvals.

Column Customization Settings

The **Column Customization** option allows you to select the default columns that you want to show or hide on each page of the Workflow Administration Console. This option is available for the Forms Catalog, Notification Template, Workflow Catalog, and Workflow Monitoring pages.

For each page, you will find few columns listed in the **Selected Columns** by default. Out of those, one or more columns cannot be hidden. This ensures that the page is not blank, it shows some details to the user on loading.

For example, if you want to customize the columns on the **Forms** page, perform the following actions:

- 1 Expand the **UI Display Settings** drop-down option on the Settings page.
- 2 Click the **Column Customization** tab.
- 3 Choose **Forms Catalog** from the drop-down list.
By default, **Form Name**, **Form Type**, **Created By**, **Created On**, and **Actions** are displayed under the **Selected Columns** list. Out of these columns, **Form Name** and **Actions** columns cannot be hidden.
- 4 Drag and drop the columns that you want to show from the **Available Columns** list to **Selected Columns** or vice versa to hide any column. In the **Selected Columns** list, you can also arrange the sequence in which you want the columns to display.
- 5 Click **Save** to apply the changes.

NOTE: A user can also select the columns that they want to show or hide using the **Column Customization** icon provided on each page. However, those selection are not saved. Next time when they navigate to that page, default columns that are configured from the **Column Customization** tab in **Settings** will be shown.



Working with Forms Catalog

This section provides an overview of the forms catalog and its usage in the Workflow Administration Console.

NOTE: You must have the appropriate permissions to access the forms catalog and perform tasks on the Forms page. To determine your access permissions, contact your administrator.

- ◆ [Chapter 5, “Forms Catalog Overview,” on page 31](#)
- ◆ [Chapter 6, “Managing Forms in Forms Catalog,” on page 33](#)

5 Forms Catalog Overview

The forms catalog is a component of the Workflow Administration Console that contains all forms used by the workflows. The forms catalog allows you to create, read, update, and delete workflow forms. It also provides the basic and advanced search functionality that enables you to search for forms based on attributes, such as form name, identifier, form type, created or updated by, created or updated on, and publishing state.

To view all forms in the forms catalog, navigate to [Catalog > Forms](#).

About Forms

Forms are an integral part of any application that involves workflows. In a workflow, you use forms for different activities. For example, if you want to include an approval activity in a workflow, you must associate an approval form with that activity. The application makes use of this form to coordinate the approvals for granting a permission access.

Workflow Administration Console segregates the workflow forms into three main categories, namely Request, Approval, and Template, and provides a set of default request and approval forms under the forms catalog. It is recommended that you do not edit the default forms. However, you can use these forms to create new forms. For more information, see [“Creating New Forms” on page 35](#).

About Request Forms

Workflow Administration Console provides a default Request Form with a set of predefined fields. In a workflow, you can associate this form with the [Start Activity](#). If you want to use a different request form, create a custom request form using Form Builder and associate that form with the workflow.

NOTE: Request forms are used only for start activities. Only one request form can be associated per workflow.

About Approval Forms

Workflow Administration Console provides a default Approval Form with a set of predefined fields. In a workflow, you can associate this form with the [Approval Activity](#). If you want to use a different approval form, create a custom approval form using Form Builder and associate that form with the workflow.

NOTE: Approval forms are only used for approval activities. You can define multiple approval forms for a workflow, but associate only one approval form per approval activity.

About Template Forms

The third category of forms is the template forms. Similar to the default request and approval forms, template forms can be copied and used for creating custom request and approval forms specific to a workflow. But first, you must design a template form. A helpdesk form is a good example in this case. Selecting the form type as `Template` while creating a new form, you can design a helpdesk template form with predefined fields that are common across all permissions, such as name, organization, and department of an employee. When there is a specific requirement, for example to create custom request and approval forms for requesting permission access to printers in your organization, you can easily create a copy of this helpdesk template form and add custom fields specific to the printer permission access.

For more information on how to create template forms, see [“Creating a New Form from Template Forms” on page 36](#).

About Form Builder

Form Builder is a web-based service used for designing forms. Workflow Administration Console integrates Form Builder with the forms catalog to enable you to create and manage forms for your workflows.

Form Builder allows you to create new request and approval forms. These forms can be associated with the Workflow activities in Workflow Builder. In addition to form building capabilities, Forms Builder enables you to edit the forms in JS Editor, add macros, and seamlessly pass the user and approver submissions to the associated workflows. For more information on Form Builder and the capabilities it offers, see [“Form Builder” on page 13](#). For detailed information on using Form Builder, see the [Administrator’s Guide to the Form Builder](#).

6 Managing Forms in Forms Catalog

You can perform the following operations on the **Forms** page:

- ◆ “Listing Forms” on page 33
- ◆ “Creating New Forms” on page 35
- ◆ “Exporting and Importing Forms” on page 37
- ◆ “Form Actions” on page 37
- ◆ “Modifying a Published Form” on page 38
- ◆ “Deleting Forms” on page 39

Listing Forms

All forms in the workflow database are listed on the **Forms** page. This includes a set of default request and approval forms provided by the application. You can use the pagination option to navigate through this list and specify the number of entries that can be displayed at a time. You can also search and filter the list to find specific forms.

Finding a Form

To find a specific form, you can use any of the following options:

Simple Search

Enter any form name or identifier in the search bar.

Filtered Search

To filter the search for forms, click the **Filter** icon and specify any of the following criteria:

- ◆ Type of form: request, approval, or template
- ◆ Person who created or updated the form
- ◆ Date when the form was created or last updated
- ◆ State of form: published or not published

You can add two or more criteria on this window to see a more refined list. To add a new filter, click the **Add new filter** icon, then choose from any of the available criteria and specify a value for it.

Combined Search

You can also combine simple search with one or more filters to obtain a more refined search result. For example, suppose that you are searching for a specific form to request for a laptop. To find this form, type “laptop” in the search field, then click the **Filter** icon. Select **Form Type** from the drop-down list, specify the value as **Request**, then click **Filter**.

Sorting the List by Columns

By default, all forms on the **Forms** page are sorted based on their creation time, displaying the most recently created form on top of the list. You can reorder the sequence of listing based on the column of your choice. For example, click the sort icon next to the **Form Name** to sort the forms in an alphabetical order. Subsequently, you can shuffle this list in ascending or descending order by clicking the same sort icon.

Sorting is supported for the following columns:

- ◆ Form Name
- ◆ Form Type
- ◆ Created By
- ◆ Updated By
- ◆ Created On
- ◆ Updated On

Customizing the Columns

When you navigate to the **Forms** page, you see the columns that are selected to display by default. However, you can choose the columns to display as desired by using the **Column Customization** option.

To customize the columns:

- 1 Click the **Column Customization** icon.
- 2 Select the check box next to the desired column that you want to display. The selected columns are added simultaneously to the **Forms** page.




TIP: To choose all columns, select the check box provided near the search field.

- 3 Click the close sign (x) on the **Column Customization** window.

NOTE: Workflow Administration does not save your customization. Next time when you navigate to the **Forms** page, columns that are configured to display by default will be shown. Alternatively, if you have appropriate permissions, you can set your preferences as default from the **Settings** page. For more information, see [“Column Customization Settings” on page 27](#).

Form Legends

Workflow Administration Console uses certain legends to indicate the publishing state of a form, whether it is unpublished, published, or in editing state. The following table helps you to interpret the form legends and take required actions:

Legend Used	Form State	Indicates that...
	Form is published	The form is in published state and can be associated with any workflow.
	Form not published	The form is saved in the database but is not in a published state. It cannot be associated with any workflow.
	Form has unpublished changes	A published version of the form is present in the database, but there are additional changes which have not been published yet. Forms in this state can be associated with a workflow, however, the new changes will not reflect in the attached form.

Creating New Forms

The application provides you a set of default request and approval forms that can be used with any workflow. While creating a workflow, you can associate these default forms with the workflow's Start and Approval activities. However, for some workflows, you may require to create new request and approval forms. Workflow Administration Console enables you to create new forms using Form Builder.

The following sections provide procedures on how to create new forms in the forms catalog.

- ♦ [“Creating New Request, Approval, or Template Form” on page 35](#)
- ♦ [“Creating a New Form by Copying an Existing Form” on page 36](#)
- ♦ [“Creating a New Form from Template Forms” on page 36](#)

Creating New Request, Approval, or Template Form

The **Forms** page provides you option to create new request and approval forms for specific workflows. To save time, you can also design template forms with common fields and use them to create new forms.

To create a new request, approval, or template form:

- 1 Click the **Create** icon on the **Forms** page.
- 2 In the **FORM BASIC DETAILS** window, specify a name and unique identifier for the form. Allowed characters are A-Z, a-z, 0-9, and special characters.

IMPORTANT: Only few special characters are allowed in the **Form Identifier** field. This includes period (.), underscore (_), hyphen (-), at sign (@), and colon (:).

- 3 Do one of the following:
 - ♦ If you want to create a new request or approval form, select the **Form Type** as:
 - ♦ **Request:** These forms are used for request activity in a workflow.

- ♦ **Approval:** These forms are used for approval activity in a workflow.
 - ♦ If you want to create a template form, select the **Form Type** as **Template** from the drop-down list. This form can be used as templates for creating other forms. For more information on how to create new forms from a template form, see [“Creating a New Form from Template Forms” on page 36.](#)
- 4 Click **Create**. Form Builder is launched in a new browser tab.
 - 5 Drag and drop form components, configure related settings, and save the form. For help on how to use Form Builder, see [Administrator’s Guide to Form Builder](#).
 - 6 Select the Workflow Administration Console browser tab to return to the **Forms** page.
 - 7 Click the **Refresh** icon to update the **Forms** page manually.
 - 8 In the **Actions** column, click the **Publish** icon to publish the form.

Creating a New Form by Copying an Existing Form

The easiest way to create a new form is to copy an existing form in the forms catalog.

To create new form from an existing form:

- 1 On the **Forms** page, identify the form that you want to copy.
- 2 In the **Actions** tab, click the **Create as a copy** icon.

The application creates a duplicate form by copying the basic details from the original form and adds “Copy of <original_form_name>” to the **Form Name** and **Form Identifier** attributes. You can choose either to retain those values or modify them as required.
- 3 Click **Create**. Form Builder is launched in a new browser tab.

All form components are also duplicated which can be customized using Form Builder.
- 4 Modify the existing form fields as required. To add new fields, drag and drop form components, configure related settings, and save the form. For help on how to use Form Builder, see [Administrator’s Guide to Form Builder](#).
- 5 Select the Workflow Administration Console browser tab to return to the **Forms** page.
- 6 Click the **Refresh** icon to update the **Forms** page manually.
- 7 In the **Actions** column, click the **Publish** icon to publish the form.

Creating a New Form from Template Forms

To create a new form from a template form:

- 1 On the **Forms** page, identify the form template that you want to use.
- 2 In the **Actions** tab, click the **Create as a copy** icon.
- 3 In the **FORM BASIC DETAILS** window, the basic form details that was selected in the template form are auto-populated into the new form. You can choose either to retain those values or modify them as required.
- 4 Click **Create**. Form Builder is launched in a new browser tab.
- 5 Modify the existing form fields as required. To add new fields, drag and drop form components, configure related settings, and save the form. For help on how to use Form Builder, see [Administrator’s Guide to Form Builder](#).

- 6 Select the Workflow Administration Console browser tab to return to the **Forms** page.
- 7 Click the **Refresh** icon to update the **Forms** page manually.
- 8 In the **Actions** column, click the **Publish** icon to publish the form.

Exporting and Importing Forms

After you have created and published your forms you can export them from one environment and import them to another environment depending on your [access permissions](#). For example, you can export from a test environment and import to production. You can also export and import forms that are not associated with a workflow. However, you cannot delete a form that is associated with a workflow.

There is no limit to the number of forms that you can export, but you cannot import more than the configured size limit. If you import a number of forms, the Workflow Administration Console informs you of the status of each form, including whether the import was successful. Note that you must re-import any forms that fail to import.

While importing a form, if the Workflow Administration Console has a form with the same name, it overwrites the existing data with the imported data.

To export or import forms:

- 1 Click **Catalog > Forms**.
- 2 Select the check box for one or more forms, and click the **Export Forms** icon.
- 3 Type a file name to export.
- 4 Click **Export**.

The Workflow Administration Console creates a zipped file which includes the selected forms in JSON format. Click the zipped file to download.

- 5 To import forms, click the **Import Forms** icon and click **Choose**.

Navigate to the folder where your forms zip file is located, then click **Open**. The application displays the associated files included in the zipped folder.

- 6 Click **Import**.

The forms that you import continue to be in a draft state until you decide to publish.

Form Actions

You can perform the following actions on the **Forms** page:

Publish

Allows you to publish a form so that it can be associated with a workflow. The **Publish** icon is enabled only in two conditions:

- ◆ when you create a form for the first time, and
- ◆ when a form has unpublished changes

You can identify a published form by a tick sign next to the form name. For more information on form legends, see [“Form Legends” on page 34](#).

Workflows

Displays a list of workflows that are using the selected form. You can also view details such as name, ID, description, and status of the workflows using the given form.

NOTE: A form can be associated with one or more workflows, which can be either in published or unpublished state. Nonetheless, Workflow Administration Console displays only those workflows that are in published state.

Restore

Allows you to restore the selected form to its previous published version. The **Restore** icon is enabled only for forms with unpublished changes. For more information on how to use the restore action, see [Restoring Previous Version of a Form](#).

Create as a copy

Allows you to create a new form by duplicating an existing form. For more information, see [“Creating a New Form by Copying an Existing Form” on page 36](#).

Restoring Previous Version of a Form

The restore option enables you to undo the saved changes on a form and restore the previous published version. This applies only if the saved changes are not published yet. The restore action is useful when you encounter an issue with the edited version of a form and want to recover the previous published version.

Consider the following points when performing the restore action:

- ◆ When you restore a form to its previous published version, all changes present in the edited version will be lost. You cannot undo this action.
- ◆ The **Restore** icon is disabled for forms which have not been published even once.

To restore a form, identify the form first, click the **Restore** icon, then click **Confirm** to submit.

Modifying a Published Form

After publishing a form, you might require to add additional fields or change the properties of existing fields. In Workflow Administration Console, you can easily modify a form using Form Builder. Every time a form is modified, the **Forms** page updates the user name and time stamp of this event in the **Updated By** and **Updated On** columns respectively. This information can be useful for tracking and determining when the most recent update was, and who made it.

To modify a form:

- 1 Click the form name link to launch Form Builder in a new browser tab.
- 2 Modify the form as required and save the changes. For help on how to use Form Builder, see [Administrator’s Guide to Form Builder](#).
- 3 Select the Workflow Administration Console browser tab to return to the **Forms** page.
- 4 Click the **Refresh** icon to update the **Forms** page manually.
- 5 In the **Actions** tab, click the **Publish** icon to publish the form.

NOTE: ♦ We recommend you to create and modify a copy of the default request and approval form, rather than modifying the original. For more information on how to create copy of a form, see [“Creating a New Form by Copying an Existing Form” on page 36](#).

- ♦ If you modify a form that is already associated with a workflow, the changes will not update in the attached form until you publish it. After you publish the form, the workflow is automatically updated with the latest version of that form.
-

Deleting Forms

To delete a form, select the check box next to the form name and click the **Delete** icon. You can also select multiple forms for deletion at one time.

IMPORTANT: You cannot delete a form associated with a workflow. The check box is disabled until you remove that form from all the associated workflows.

IV

Working with Workflow Catalog

This section provides an overview of the workflow catalog and its usage in the Workflow Administration Console.

NOTE: You must have the appropriate permissions to access the workflow catalog and perform tasks on the Workflows page. To determine your access permissions, contact your administrator.

- ◆ [Chapter 7, “Workflow Catalog Overview,” on page 43](#)
- ◆ [Chapter 8, “Managing Workflows in a Catalog,” on page 45](#)

7 Workflow Catalog Overview

Workflows are used to initiate workflow processes to manage the approval and removal of user access in the secure system of an organization. Requests that require approval from more than one individual, starts one or more workflows.

Workflows help to reduce the administrative burden of entering, updating, and deleting user information across all systems in the enterprise. These workflows provide a web-based interface for users to manipulate distributed identity data that triggers workflows as necessary.

The workflow catalog in Workflow Administration Console lists all the workflows created using the Workflow Builder. The workflow catalog can search based on workflow name, description, or category, and it provides the option to edit the workflow definition by launching the workflow builder.

The Workflow Administration Console includes two system-defined workflows that can be used directly for approval request or copied to create new workflows.

8

Managing Workflows in a Catalog

The workflow catalog allows you to launch Workflow Builder, and manage all the workflows that you create, edit, or publish. You can drag the components from the palette, and drop them on the canvas to create the workflow. For more information, see [Chapter 9, “Using Workflow Builder to Create Workflows,”](#) on page 55.

To access the Workflows page, click **Catalog > Workflow**. For information regarding tasks that you can perform on the Workflows page, see the following sections:

- ♦ [“Creating a Workflow”](#) on page 45
- ♦ [“Editing a Workflow”](#) on page 46
- ♦ [“Exporting and Importing Workflows”](#) on page 48
- ♦ [“Deleting a Workflow”](#) on page 48
- ♦ [“Restoring a Workflow”](#) on page 49
- ♦ [“Publishing a Workflow”](#) on page 49
- ♦ [“Viewing Workflow Association”](#) on page 49
- ♦ [“Listing Workflows”](#) on page 49
- ♦ [“Using the System Templates for Workflows”](#) on page 51

Creating a Workflow

If you have appropriate permissions you can use Workflow Builder to create workflows. Workflows you create and publish, are stored in the database and used for approvals of user requests.

To create a workflow:

- 1 Select **Catalog > Workflow**.
- 2 Click the plus sign (+).
- 3 Enter a unique identifier, and a name for the workflow.

NOTE: The **Identifier** field supports the special character, underscore (_). However, after you save a workflow, you cannot change a unique identifier.

- 4 Type a description.
- 5 (Optional) Click the **Choose Template** drop-down if you want to create the workflow based on a template. You can edit the workflow from the Workflow Builder.
- 6 Click **Create Workflow**.
- 7 Use Workflow Builder to create or edit the workflow.
- 8 Save or publish the workflow.
- 9 Close the window to return to the Workflows page.

NOTE: For associating a system template workflow or a custom workflow to Identity Governance approval or fulfillment policy, you must select the respective Identity Governance request form in the [Start Activity](#).

Copying a Workflow

You can use the copy function to create a new workflow from an existing workflow.

To copy a workflow:

- 1 Click **Catalog > Workflow**.
- 2 Click **Create as a copy** for the workflow you want to copy.
- 3 Enter a new unique identifier, workflow name, and description for the workflow.
If you do not provide new details, the application uses details such as identifier, name, and description from the original workflow.
- 4 Click **Create Workflow**.
- 5 Use Workflow Builder to make any change.
- 6 Save or publish the workflow.
- 7 Close the window to return to the Workflows page.

Editing a Workflow

You can edit a workflow that is in the published, unpublished, or in the edit state.

To edit a workflow:

- 1 Click **Catalog > Workflow**.
- 2 Click the workflow name listed on the Workflows page.
- 3 (Optional) If you want to edit the workflow, click the **Workflow Builder** tab.
- 4 (Optional) If you want to edit details such as name, description, or category of the workflow, click **Overview** tab. For more information, see [“Editing Properties on the Overview Tab” on page 46](#).
- 5 Save or publish the workflow.
- 6 Close the window to return to the Workflows page.

Editing Properties on the Overview Tab

The **Overview** tab allows you to edit basic information about the workflow, such as the name and description of the workflow, the category to which it belongs, and its status.

The following list defines some of the fields on the **Overview** tab:

Field	Description
Status	<p>Specifies the status of the workflows.</p> <p>Active: The workflow is available for use in the application.</p> <p>Inactive: The workflow is temporarily unavailable for use in the application.</p> <p>Template: The workflow can be used as the basis for other workflows. Templates are not available for use in the application.</p>
Flow Strategy	<p>Select one of the following options:</p> <p>Single Flow: One workflow is used with one recipient.</p> <p>Flow Per Member: The recipient can be a group DN. When you select this strategy, the application starts a workflow instance for each member of the group, and each workflow can be approved or denied separately.</p> <p>Single Flow Provision Members: The recipient can be a group DN. When you select this strategy, the application starts a single workflow instance for the group. The workflow spawns multiple provisioning steps (one for each member) within the single workflow. The workflow is approved or denied to the group as a whole, not for each individual member.</p>
Category	<p>Specifies the category in which the workflow belongs. Used for filtering workflows. You can add categories based on the requirement. To add categories, access Settings > Workflow Catalog > Category. For more information, see “Add a Category or Process Type” on page 25.</p>
Process Type	<p>Specifies the workflow type. Normal is selected by default. To add process type, access Settings > Workflow Catalog > Process Type. For more information, see “Add a Category or Process Type” on page 25.</p>
Notify Participants By Email	<p>If you enable this option, approvers are notified about pending approval tasks, and initiators are notified of workflow completion. For information on selecting an email template and customizing email template parameters, see “Finish Activity” on page 72.</p>
Generate Comments	<p>If you enable this option, the workflow engine generates comments as the workflow progresses. These comments are displayed under Monitoring > Actions.</p>

Field	Description
Default Completion Status As Approval	If you enable this option, the default completion status of the provisioning request is considered “approved”.

Exporting and Importing Workflows

To simplify the process of migrating workflows from one environment to another, the Workflow Administration Console allows you to use the export and import feature depending on your [access permissions](#). The workflows are exported in a zip format, which you can import to your environment. You can then use the Workflow Builder to edit the imported workflows. The console maintains all imported workflows in draft state and requires you to publish again before using them.

There is no limit to the number of workflows that you can export, but you cannot import more workflows than the configured size limit. If you import a number of workflows, the Workflow Administration Console informs you of the status of each workflow, including whether the import was successful. Note that you must re-import any workflows that fail to import.

While importing, if the Workflow Administration Console has a workflow, form, or template with the same name, it overwrites the existing data with the imported data.

To export or import workflows:

- 1 Click **Catalog > Workflow**.
- 2 Select the check box for one or more workflows, and click the **Export Workflows** icon.
- 3 Type a file name to export.
- 4 Click **Export**.

The Workflow Administration Console creates a zipped file containing the selected workflows, and under each workflow file its associated data, such as, request and approval forms, and notification templates. Click the zipped file to download.

- 5 To import workflows, click the **Import Workflows** icon and click **Choose**.

Navigate to the folder where your workflows zip file is located, then click **Open**. The application displays the associated forms and notifications included in the zipped file.

- 6 Click **Import**.

When you publish an imported workflow, the associated forms and templates are also published.

Deleting a Workflow

To delete a workflow, select the check box next to the workflow that you want to delete and click **Delete**. You can select multiple workflows for bulk deletion. Click **Associations** to check the policies associated with the workflow before deleting.

Restoring a Workflow

You can restore workflows that are in the state, “Workflow has unpublished changes”. The restore function helps you to return to the previous version of the workflow if needed. However, you will lose your latest edit.

To restore a workflow, click **Restore**, and **Confirm**.

Publishing a Workflow

To Publish a workflow, click the workflow name on the Workflows page. When the Workflow Builder opens, click **Publish**.

Viewing Workflow Association

You can associate a workflow to one or more access request policies. You can create the workflow from Identity Governance or from the Workflow Administration Console, but you must associate the workflow with the policy from the Identity Governance application. For information on how to associate a workflow to a policy, see [Using Workflows to Approve Requests](#) . You can launch Identity Governance from the Workflow Administration Console by clicking the home icon, or you can log in to your unique URL using the provided user name and password.

To view the policies associated with the workflow, in the Workflow Administration Console select **Catalog > Workflow > Associations**. Select **Details** to view the permissions, applications, or roles associated with the policies.

Listing Workflows


Access to the Workflows page allows you to perform certain activities such as listing, searching, sorting, and customizing columns.



Sorting Workflows

The workflows are listed by creation date, with the latest template listed first. You can click the sort arrows next to the workflow **Name** column and sort the columns based on the following:

- ◆ Name, description, and the category
- ◆ Alphabetical order
- ◆ Ascending or descending order

The Workflow Administration Console uses certain symbols to show the state of listed workflows. This table lists the states, and their corresponding symbols:

Workflow symbols	Workflow states	Description
	Workflow is published	Available in the database, and you can use it in an approval request.

Workflow symbols	Workflow states	Description
	Workflow is not published	Available in the database, but you cannot use it in an approval request.
	Workflow has unpublished changes	Available in the database, but the workflow is edited and those edits are not published. If you use the workflow in an approval request, changes will not appear until you publish the workflow.

Searching for a Workflow

You can search and filter specific workflows. To find a specific workflow, you can use any one of the following options:

Simple

Enter the workflow name or description in the search box. Workflows with matching name and description are displayed.

Filtered

Click **Filter**, and select the workflow category.

The drop-down list displays the default categories, **Accounts**, and **System Templates** and any categories you added. For more information about adding categories, see [“Add Category and Process Type to the Workflow Catalog” on page 25](#).

After you select the category, select a workflow status from the drop-down list:

- ◆ **Active**
- ◆ **Inactive**
- ◆ **Template**

Combined

You can combine the simple search with the filter option to obtain more refined search results. For example, if you are searching for an active workflow that contains “approval” in the title, type `approval` in the search box, and click **Filter**. On the pop-up window, specify the status as **Active**, then click **FILTER**.

Customizing Columns

On the Workflows page, you can see the default columns. However, you can use the **Column Customization** option to choose the columns for display as desired.

To customize columns:

- 1 Click **Catalog > Workflow**.
- 2 Click **Column Customization**.
- 3 Select the check box next to the desired columns that you want to display. The selected columns are added to the Workflows page.

TIP: To choose all columns, select the check box provided near the search field.

4 Click the close icon (X).

NOTE: The Workflow Administration Console does not retain the customization. The next time you navigate to the Workflows page, the default columns appear. However, you can use the Settings page to choose which columns display by default. For more information, see [“Column Customization Settings” on page 27](#).

Using the System Templates for Workflows

The Workflow Administration Console includes a set of pre-built workflows that you can use to create workflows. You cannot delete these system templates nor can you edit the templates directly. However, if you want, you can [create a copy](#) of these templates and use them as the base for your workflows. Additionally while creating a workflow you can choose a template from the **Choose Template** drop-down menu, then edit the pre-built workflows using the Workflow Builder.

These templates have pre-defined fields that you can change as per your requirement. You must ensure the status of the workflow is updated to ‘Active’.

NOTE: You must have the appropriate permissions to access the workflow catalog, and perform tasks on the Workflows page. To determine your access permissions, contact your administrator.

The following table lists the templates included with the Workflow Administration Console:

Template	Description
One Step Approval	Requires single approval for the workflow request to be fulfilled.
Two Step Approval	Requires two approval for the workflow request to be fulfilled.
Rest Activity Workflow	Requires details such as API URL, authentication type, client ID, and client secret for the workflow request to be fulfilled.
Quorum Workflow	Requires the specified percentage of approvers to approve the workflow for the request to be fulfilled. For example, in a workflow with four approvers if you specify 50 as the quorum percent, when two approvers approve the workflow request, the process is considered fulfilled.
IGA One Step Approval	One step approval template for Identity Governance.
IGA Two Step Approval	Two step approval template for Identity Governance.
IGA Rest Activity Workflow	Rest activity workflow template for Identity Governance.
IGA Quorum Workflow	Quorum workflow template for Identity Governance.

NOTE: ♦For associating a system template workflow or a custom workflow to Identity Governance approval or fulfillment policy, you must select the respective Identity Governance request form in the [Start Activity](#).

- ♦ The templates prefixed with 'IGA' are specific to Identity Governance and include the Identity Governance request form in the Start Activity.
 - ♦ To ensure that the system template or a custom workflow created in the Workflow Administration Console integrates properly in Identity Governance, you must use the source expressions from the IGA default approval workflow while using the [Notify Activity](#).
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Workflow Builder Overview

This section will guide you on how to use Workflow Builder and its activities to create and modify workflows for your organization.

NOTE: You must have the appropriate permissions to access and perform tasks on the Workflow Builder. To determine your access permissions, contact your administrator.

- ♦ [Chapter 9, “Using Workflow Builder to Create Workflows,” on page 55](#)
- ♦ [Chapter 10, “Workflow Activity Reference,” on page 69](#)
- ♦ [Chapter 11, “Working with ECMA Expressions,” on page 113](#)

9 Using Workflow Builder to Create Workflows

The following sections provide all information you need to know about Workflow Builder and how to use it to build workflows for your application:

- ♦ [“About Workflow Builder” on page 55](#)
- ♦ [“Adding Activities to a Workflow” on page 57](#)
- ♦ [“Adding Flow Paths” on page 60](#)
- ♦ [“Configuring Flow Paths” on page 60](#)
- ♦ [“Guidelines for Creating Workflows” on page 62](#)
- ♦ [“Debugging a Workflow” on page 67](#)

About Workflow Builder

The Workflow Builder interface consists of a [Canvas](#), [Palette](#), and [Associated Views](#).

To create a workflow diagram, drag the required activities from the palette, drop them in the canvas area, then configure their properties in the right-side properties window. Connect one activity to another using the connection tool. Use the associated views to define the data item mapping, email template settings and to view the problems associated with a workflow.

Canvas

The canvas is a space where you design and work on the workflow diagram. It provides a graphical view of the activities that build up an entire workflow. To move around and view different parts of your workflow, click any empty space in the canvas and drag the screen to your desired view. The canvas also provides the following options to make workflow viewing easier:

Zoom out and Zoom in

Click the **Zoom out** and **Zoom in** icons to decrease and increase the magnification of the workflow display. You can maximize the workflow to display a detailed view, or minimize the workflow for a compact view.

Click the **Resize** icon to return to the default size of the canvas.

MiniMap View

Click the **MiniMap** icon to see the whole workflow diagram in the MiniMap window. MiniMap provides a minimized view of the entire workflow in a small window. You can also click and drag the highlighted rectangle to view a specific area of the workflow diagram on the main canvas.

You will also notice an Errors and Warnings banner on the canvas. A green banner with 0 errors and 0 warnings indicates that a workflow has passed the validation check. However, the banner turns red if your workflow fails the validation check. For more information on validation rules, see [“Validating a Workflow” on page 60](#). Click the **Problems** icon to display the errors and warnings reported on a workflow. You must resolve the reported errors and warnings before publishing.

NOTE: When you create a new workflow without using a template, the canvas is blank except for 2 errors which indicates that the workflow is missing a Start activity and a Finish activity. For general guidelines that must be followed before creating any workflow, see [“Guidelines for Creating Workflows” on page 62](#).

Palette

The palette contains an array of activities that you can drag onto the canvas to create a workflow. In addition, the palette also provides two basic tools, one for selecting and the other for creating connections in a workflow.

The following table gives you a detailed description of all tools available in the palette:

Table 9-1 Workflow Builder Palette

Tool	Description
Global connect tool	Creates flow paths between activities. Flow paths provide connection logic for linking two activities. For more information about connecting activities, see “Adding Flow Paths” on page 60 .
Lasso tool	Selects multiple activities or flow paths. Use this tool to move items as a group. To select multiple items, click the Activate the lasso tool icon, then hold down the mouse button in an area outside of the items that you want to select and drag over the items, then release the mouse button. When you select multiple items, the properties window displays properties for the first item selected (see “Associated Views” on page 56 for more information).
Activities (for example, Start, Approval, Log)	Inserts the selected activity into the workflow. For more information about adding activities, see “Adding Activities to a Workflow” on page 57 . For detailed descriptions of the activities, see Chapter 10, “Workflow Activity Reference,” on page 69 .

Associated Views

For each selected item on the canvas, Workflow Builder includes the following associated views:

- ◆ Properties
- ◆ Data Items
- ◆ Problems
- ◆ Email Template

Not all activities utilize all views. The following table identifies the views and the activities that use them:

Table 9-2 Associated Views for Activities

Activity	Properties	Data Items	Problems	Email Template
Create Start Activity	✓	✓	✓	
Create Finish Activity	✓		✓	✓
Create Approval Activity	✓	✓	✓	✓
Create Log Activity	✓		✓	
Create Condition Activity	✓		✓	
Create Mapping Activity	✓	✓	✓	
Create WorkflowStatus Activity	✓		✓	
Create Email Activity	✓		✓	✓
Create Rest Activity	✓		✓	
Create Notify Activity	✓		✓	
Create Integration Activity	✓	✓	✓	
Create Subprocess Activity	✓		✓	

Adding Activities to a Workflow

Activities are the building blocks of your workflow. Each activity has a predefined purpose in the workflow. Workflow Builder provides you multiple activities to choose from to build custom workflows.

While creating a new workflow diagram, you must always start with a Start activity and end the workflow with a Finish activity, then connect both these activities together with a flow path. You can insert an activity between two activities by dropping it onto the flow path.

The following procedure shows you how to add a Start activity and Finish activity to an existing workflow. It assumes that only the basic parameters have been defined for this workflow.

- 1 In the Workflow Administration Console, go to **Catalog > Workflow** and select the workflow to which you want to add the activities. The workflow opens in the **Workflow Builder** tab.
- 2 Drag the **Create Start Activity** icon from the palette and place it in the canvas at desired location.

Set the properties of this activity (see [“Setting the General Properties of an Activity” on page 58](#)). For detailed information about configuring the Start activity, see [Chapter 10, “Workflow Activity Reference,” on page 69](#).

- 3 To add a Finish activity, drag the **Create Finish Activity** icon from the palette and place it in the canvas below the Start activity.

Next add a forward flow path in between the two activities. For more information, see [“Adding Flow Paths” on page 60](#).

Setting the General Properties of an Activity

The name and identifier are common to all activities. Workflow Builder auto-generates an identifier in the `<Activity>_<N>` format, where `<Activity>` represents the name of an activity and `<N>` represents an alphanumeric value consisting of 7 characters. It is unique and non-editable for each activity.

An activity has a common name that you can change. We recommend that you replace the common name of an activity with a descriptive string that describes the specific purpose of that activity in the workflow. This makes it easier to understand the workflow when you look at the workflow diagram.

You can either set the properties of an activity just after adding it to a workflow diagram, or later select that activity on canvas and define its properties. If any required property is found empty, the Errors and Warnings banner on the canvas will turn red, indicating the number of errors and warnings in that workflow. To know more about these errors, click the **Problems** tab located below the canvas.

Defining the Data Items for an Activity

You can use the **Data Items** tab to map data from the data flow into the fields in a form (pre-activity mapping) and to map data from the form back to the data flow (post-activity mapping).

To define data items for an activity:

- 1 On the canvas, click the activity icon for which you want to set data items.
You can also view the **Data Items** tab by simply dragging the window located below the palette. **Data Item** tab is selected by default.
- 2 For pre-activity mapping, click in the **Source Expression** field for the item that you want to map, then specify an expression.

Pre-activity maps can be used for:

- ◆ Initializing form control values.
- ◆ Setting default values for form controls.
- ◆ Populating complex form controls with data lists derived from LDAP queries.
- ◆ Passing data from form controls of a previous activity to a form control in the current activity.
- ◆ Calling external Java classes to process data.

Leave the Source Expression blank in pre-activity maps for form fields that the user is expected to fill in. Alternatively, create a source expression to supply a default value for form fields that the user is expected to fill in. In either case the form field needs to be defined as editable while creating the form in Form Builder. See [Administrator's Guide to the Form Builder](#) for information about setting the properties of form fields.

- 3 For post-activity mapping, go to the **Post Activity** tab and click in the **Target Expression** field for the item that you want to map, then specify an expression. You can use the **MAP ALL** button to automatically generate the target expression for all source form fields.

Post-activity maps can be used for:

- ♦ Creating new data items in flowdata.
- ♦ Moving form control data from an activity into flowdata.
- ♦ Calling external Java classes to process data.

For detailed information about data item mapping for the different types of activities, see [Chapter 10, "Workflow Activity Reference," on page 69](#).

The Start Activity can have hard-coded strings, system variables like process locale and recipient, and Identity Vault expressions (created using the ECMA Script Builder Modal window) in pre-activity maps.

Defining the Email Template Settings

You can use the **Email Template** tab to select an email template, and to specify expressions to provide values for named parameters included in the email template. Emails are sent when a new Approval activity starts (to notify approvers that they have work to do) and when the Finish activity completes (to notify the initiator that the workflow is done).

To define the email template settings:

- 1 On the canvas, click the activity icon for which you want to configure the email template settings.
- 2 Go to the **Email Template** tab, select an email template from a list of defined templates.
Localized email templates: By default, the **Email Template** tab displays email notification templates that are in default language. When you select a template from the list, the email is in the user's default language (if the default is a supported language). So, while notifying a user, the Workflow Engine sends the email in the user's default language using the selected notification template. If the selected template is not available in required language, the Workflow Engine sends the email in the default language.
Editing an email template: You can edit an email template from the **Notification Templates** page in the Workflow Administration Console. For more information, see ["Editing a Notification Template" on page 121](#).
- 3 Click the **Source** field for a **Target** token and specify an ECMAScript expression that assigns a value to the token.

See [Chapter 10, "Workflow Activity Reference," on page 69](#) for information about email notification settings.

Validating a Workflow

Validating a workflow is an important step in creating a workflow, even though it does not guarantee that every process will be completed successfully. Validation helps to limit the possibility for errors during the deployment.

While you are creating a workflow, you must follow guidelines for adding activities and connecting them. Workflow Builder performs a set of predefined validation check on the workflow. Any violation, if detected, is displayed in the **Problems** tab with an error or warning message against an ID. You can click the ID to locate the activity on the canvas and resolve the reported errors and warnings before publishing.

A workflow can display a validation error even though it showed 0 errors and 0 warnings in the banner. At the time of publishing, Workflow Engine checks the workflow on the server and displays a validation failure message if your workflow violates the guidelines of workflow creation. For more information, see [“Guidelines for Creating Workflows” on page 62](#).

Workflow Administration Console also uses XML Schema Definition (XSD) to validate the workflow XML. This schema document contains a set of rules to which a workflow XML document must conform to be considered “valid” according to that schema. These additional validations help reduce potential issues that might develop when deploying a workflow. The XSD validation is enabled by default.

Adding Flow Paths

Flow Paths are the logical connections between any two activities. There are different types flow paths depending on the activities that they connect (see [Table 9-3, “Different types of Flow Paths and its description,” on page 61](#)).

To connect two activities with a flow path:

- 1 Click the **Activate the global connect tool** icon in the palette.
- 2 Click the activity from which you want the flow path to begin, then click the activity on which you want the flow path to end. The activities are connected.
- 3 To configure the flow path, click the **Activate the lasso tool** icon in the palette, click the flow path, then select values for the required parameters in the **SEQUENCE FLOW ACTIVITY** window. For information about configuring flow paths, see [Configuring Flow Paths](#).

Configuring Flow Paths

After adding a flow path to a workflow diagram, you can specify the path type. Flow paths are color-coded. Different colors indicate different flow path type.

To configure a flow path:

- 1 Click the flow path in the workflow diagram.
- 2 In the **SEQUENCE FLOW ACTIVITY** window, set the flow type by selecting one of the options in the **Type** drop-down list.

The following table gives you a brief description of the flow path types and the colors that they use:

Table 9-3 Different types of Flow Paths and its description

Flow Path Type	Description
forward	<ul style="list-style-type: none">◆ Forwards control to the next activity in a workflow.◆ The forward flow path is available after all activities except:<ul style="list-style-type: none">◆ Approval◆ Condition◆ Finish◆ Displayed in blue color.
approved	<ul style="list-style-type: none">◆ Determines what happens when a user approves a request.◆ The approved flow path is valid only after the Approval activity.◆ Displayed in green color
denied	<ul style="list-style-type: none">◆ Determines what happens when a user denies a request.◆ The denied flow path is valid only after the Approval activity.◆ Displayed in red color.
refused	<ul style="list-style-type: none">◆ Determines what happens when a user refuses a request.◆ The refused flow path is valid only after the Approval activity.◆ Displayed in red color.
timeout	<ul style="list-style-type: none">◆ Determines what happens when an Approval activity times out because the user did not respond.◆ The timeout flow path is valid only after the Approval activity.◆ Displayed in red color.
error	<ul style="list-style-type: none">◆ Determines what happens when an Approval or Condition activity terminates with an error.◆ The error flow path is valid only after the Approval and Condition activities.◆ Displayed in red color.
true	<ul style="list-style-type: none">◆ Determines what happens when a conditional expression evaluates to True.◆ The True flow path is valid only after the Condition activity.◆ Displayed in green color.
false	<ul style="list-style-type: none">◆ Determines what happens when a conditional expression evaluates to False.◆ The False flow path is valid only after the Condition activity.◆ Displayed in red color.

3 Click the **Save** icon to save the flow path configuration changes.

Guidelines for Creating Workflows

To create well-formed workflows, you need to understand the rules for adding activities and connecting them. In addition, you need to understand how to manipulate workflow data.

Rules for Activities

When adding activities to a workflow, follow these rules:

- ◆ A workflow must have only one Start activity and one Finish activity.
- ◆ A workflow can have zero or more of the following activity types:
 - Approval activity
 - Log activity
 - Branch activity
 - Merge activity
 - Condition activity
 - Mapping activity
 - Workflow Status
 - Email activity
 - Rest activity
 - Integration activity
- ◆ Each Branch activity must have a corresponding Merge activity.

Rules for Flow Paths

When adding flow paths to a workflow, follow these rules:

- ◆ With the exception of the Start activity, all activities can have one or more incoming flow paths. The Start activity cannot have any incoming flow paths.
- ◆ The Finish activity cannot have any outgoing flow paths.
- ◆ There can be only one flow path out of the Start activity. The flow path type must be forward.
- ◆ There can be between one and five flow paths out of the Approval activity. The valid flow path types are approved, denied, refused, timedout, and error. At runtime, only one of the flow paths is executed.
- ◆ There can be only one flow path out of the Log and Merge activities. The flow path type must be forward.
- ◆ There can be two or three flow paths out of the Condition activity. The valid flow path types are true, false, and error. The true and false flow paths are required; the error flow path is optional.
- ◆ There can be one or more flow paths out of the Branch activity. The flow path type must be forward for each path. At runtime, all the flow paths execute.
- ◆ There can be between one and three flow paths out of the Rest activity. The valid flow path types are forward, error, and timedout.

The following table summarizes the rules for adding flow paths into and out of an activity:

Table 9-4 Number of Flow Paths Permitted for Each Activity

Activity	Inbound Paths	Outbound Paths
Start Activity	0	1 must always be forward
Finish Activity	1 to n	0
Approval Activity	1 to n	1 to 5. Approved, denied, refused, timedout, or error
Log Activity	1 to n	1 must always be forward
Condition Activity	1 to n	2 to 3. True and false are required; error is optional
Mapping Activity	1 to n	1
Workflow Status Activity	1 to n	1 must always be forward
Email Activity	1 to n	1 must always be forward
Rest Activity	1 to n	1 to 3. Forward, timedout, error
Integration Activity	1 to n	1 to 4. Success, timedout, error, fault
Notify Activity	1 to n	1 must always be forward
Branch Activity	1 to n	1 to n
Merge Activity	1 to n	1 must always be forward

The following table summarizes which activity types can be a source or target for each of the available flow path types:

Table 9-5 Flow Path Types Allowed for Each Activity

Activity	Forward	Approved	Denied	Refused	Timedout	True	False	Error	Success	Fault
Start Activity	Source									
Finish Activity	Target	Target	Target	Target	Target	Target	Target	Target		
Approval Activity	Target	Source/ Target	Source /Target	Source/ Target	Source/ Target	Target	Target	Source / Target		
Log Activity	Source/ Target	Target	Target	Target	Target	Target	Target	Target		
Condition Activity	Target	Target	Target	Target	Target	Source /Target	Source /Target	Source / Target		
Mapping Activity	Source	Target	Target	Target	Target	Target	Target	Target		
Workflow Status Activity	Source/ Target									

Activity	Forward	Approved	Denied	Refused	Timedout	True	False	Error	Success	Fault
Email Activity	Source/Target									
Rest Activity	Source/Target	Target	Target	Target	Source/Target	Target	Target	Source/Target	Target	Target
Notify Activity	Source/Target									
Integration Activity	Source/Target	Target	Target	Target	Source/Target	Target	Target	Source/Target	Source	Source
Branch Activity	Source/Target	Target	Target	Target	Target	Target	Target	Target		
Merge Activity	Source/Target	Target	Target	Target	Target	Target	Target	Target		

Understanding Workflow Data

When you are creating a workflow, you can manipulate workflow data to suit the needs of your provisioning application.

- ♦ [“Data Objects and Variables” on page 64](#)
- ♦ [“Creating New Data Items” on page 65](#)
- ♦ [“Modifying Data Items” on page 65](#)
- ♦ [“Working with Complex Data Item Mappings” on page 66](#)
- ♦ [“Moving Form Control Data to Flowdata” on page 66](#)
- ♦ [“Moving Flowdata to Form Controls” on page 66](#)
- ♦ [“About Mapping Activity Operations” on page 67](#)

Data Objects and Variables

The workflow uses a single process object to manage information about the process. A separate activity object is created for each activity in the workflow and form data is maintained for each activity that provides user interaction.

The data objects associated with each user interface control on a form (text field, drop-down list, and so forth) can be modified immediately prior to the execution of the corresponding activity (Start activity or Approval activity). In addition, this data can be retrieved immediately after execution of the activity. After control has been passed to the next activity, the form control data is no longer available. For this reason, the workflow provides a special object called flowdata that allows you to define your own data items. You can add your own variables to this object to keep track of information that is important to your workflow, including form data that would otherwise be lost.

The following table summarizes the categories of workflow data:

Table 9-6 Categories of Workflow Data

Data Object	Lifetime	Editable	Creator
process	Workflow	No	System
activities	Workflow	No	System
activity forms	Activity	Yes	System and workflow administrator
flowdata	Workflow	Yes	Workflow administrator

NOTE: The workflow administrator is the person who creates workflow in Workflow Builder.

You can reference these objects in ECMAScript expressions. Script expressions in a workflow can at any time refer to data items that are bound upstream in the flow. However, workflow expressions cannot refer to data items that are created downstream (because these data items do not exist yet) or to data bound on other branches in a flow that supports parallel processing (because these branches could be executing concurrently with the current activity).

Creating New Data Items

You can create a new data item on the flowdata object by specifying a post-activity target expression on the **Data Items** tab for the Start or Approval activities. If you specify a name for a new data item in the **Target Expression** column, this automatically creates the variable. Any activity executed after this activity can then access the data item.

For example, you might want to map the form field called **reason** to the target expression `flowdata.myReason`. The variable `myReason` then becomes a new data item that is available to all activities executed later in the workflow.

Modifying Data Items

You can modify a data item by specifying a pre-activity expression on the **Data Items** tab for the Start or Approval activities. For example, to prepend a dollar sign to a price, you might map the following source expression to a target form field called **Price**:

```
"$" + flowdata.get('cost')
```

When the form displays to the user, the Price data appears as follows:

```
$xx.xx
```

Another example might be computing the total cost by adding the tax to the base cost. To do this, you could map the following source expression to a target form field called **TotalCost**:

```
Number(flowdata.get('cost')) + Number(flowdata.get('tax'))
```

Working with Complex Data Item Mappings

All data in the flowdata object is maintained in XML, so you can create data items in a hierarchical fashion as well. For example, suppose you have a workflow form that allows a user to ask for access to two internal systems, one for accounts payable and one for receivables. Suppose the form has (among other fields) two Yes/No fields named **Acct_Pay** and **Acct_Rec**. In the post-activity data item mappings, you might create two mappings as follows:

Table 9-7 Complex Data Item Mapping Examples

Source Form Field	Target Expression
Acct_Pay	flowdata.SystemAccess/AcctPay
Acct_Rec	flowdata.SystemAccess/AcctRec

This would create an XML element named `SystemAccess` with two child elements named `AcctPay` and `AcctRec`. One reason to structure data in this way is for clearer organization and management of data in complex workflows containing many forms and data items. To retrieve data from these hierarchies, the following syntax would be used:

```
flowdata.get('SystemAccess/AcctPay')
```

For complete details on building ECMAScript expressions, see [Chapter 11, “Working with ECMA Expressions,”](#) on page 113.

Moving Form Control Data to Flowdata

All form controls you create are automatically made available for use in pre-activity and post-activity expressions on the **Data Items** tab for the activity that uses the form. For example, suppose you want to make a user’s entry data in control `ACONTROL` on form `AFORM` in `AACTIVITY` available for use in a subsequent activity. To do this, you would select `AACTIVITY` in the workflow, select the **Data Items** tab, and click the **Post Activity** tab. Next to the source form field `ACONTROL`, you would then enter a target expression in the following format:

```
flowdata.my_ACONTROL
```

Any subsequent activity in the workflow would then be able to access this data by using pre-activity source expressions such as these:

```
flowdata.get('my_ACONTROL')
```

```
flowdata.getObject('my_ACONTROL')
```

Moving Flowdata to Form Controls

You can also move flowdata values into form controls. The simplest case is moving a single text value into a form control. In the example above, suppose `ACONTROL` is a simple text entry field. In this case, to move it into another text entry field in an activity called `ZACTIVITY`, you would select `ZACTIVITY` in the workflow, select **Data Items > Pre Activity**. Next to the target form field, you would then enter this source expression:

```
flowdata.my_ACONTROL
```

To move data into a form control, you need to be aware of type constraints. For example, you should not try to move text-based data into a numeric control.

About Mapping Activity Operations

In the mapping activity, the source expressions are evaluated before they are assigned to the target expression. If the source expression does not exist prior to the mapping activity, no value is assigned to the target expression.

For example, if `flowdata.get("textfield")` maps to `flowdata.copyoftextfield` and `flowdata.get("copyoftextfield")` maps to `flowdata.copyoftextfield2`, the value of `flowdata.copyoftextfield2` is empty at the end of the mapping activity because the value of the `flowdata.copyoftextfield` is assigned only after the mapping activity.

To assign values to the target expression, you can use either of these options:

- ♦ Multiple mapping-activities.
- ♦ Single mapping-activity but repeat the source expression.
When you repeat the source expression, the `flowdata.get("textfield")` maps to `flowdata.copyoftextfield` and `flowdata.get("textfield")` maps to `flowdata.copyoftextfield2`.

Debugging a Workflow

When testing a workflow, you might need to see the values of the variables you are using in the flow. Some options include:

- ♦ [“Using the Log Activity” on page 67](#)
- ♦ [“Changing Log Levels” on page 67](#)

Using the Log Activity

Use the Log activity to display messages containing the variables you need to look at. You can use scripting expressions in the Message property to retrieve the values you need. For example, you might use this expression to log a message containing the value of a variable defined on the flowdata object:

```
flowdata.get('my_variable')
```

For details on using the Log activity, see [Log Activity](#).

After you configure the Log activity, navigate to the Monitoring page in the Workflow Administration Console to view the messages.

Changing Log Levels

A Workflow administrator and a SaaS operations administrator can change the log levels associated with the workflow system from the Logging Configuration page in the Configuration tab of the Workflow Administration Console. This approach might generate more information than you need, but it can be helpful during the debugging process. If you require assistance with changing the logging levels, contact your SaaS operations administrator.

10 Workflow Activity Reference

The activities are the main components in a workflow process where each activity has a purpose. While creating a workflow, you must start the workflow with the “Start” activity and complete with the “Finish” activity and connect both these activities with a flow path. This section provides details on configuring the different types of workflow activities.

Start Activity

The Start activity is the first activity of a workflow. This activity begins execution when the user makes a request to provision a resource. After the user makes the request, the Start activity displays the request form to the user. The request form asks the user can be asked to provide reason for the request.

You can customize the request form to suit your application requirements. For details on customizing forms, see [Part III, “Working with Forms Catalog,” on page 29](#).

Before displaying the form to the user, the Start activity performs any pre-activity data mappings specified for the activity.

After the user submits the form, the Start activity performs any post-activity data mappings specified for the activity. These mappings typically include copying data from form fields into the flowdata object.

- ♦ [“Properties” on page 69](#)
- ♦ [“Data Items” on page 70](#)
- ♦ [“Email Template” on page 71](#)
- ♦ [“Problems” on page 72](#)

Properties

The Start activity includes the following properties:

Table 10-1 Start Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.

Property Name	Description
Form	<p>Specifies the name of the request form to display at runtime. Select the name of the form you want to use, or create a new form. For information on how to create a new form using Form Builder, see “Creating New Forms” on page 35.</p> <p>After you select the form, select the data items to include in the form from the listed data items.</p> <p>You must associate a form with a Start activity. If you do not specify a form an error message appears at runtime.</p>
Resource Name Override Type	<p>Allows you to specify the resource name type. The name can be either an ECMA expression, or a constant value.</p> <ul style="list-style-type: none"> ◆ Define expressions using the ECMA expression builder. At runtime, the expression is evaluated and replaced with a meaningful value. ◆ Type the constant value in the Resource Name Override field. The value is displayed exactly as entered in the field.
Resource Name Override	<p>Allows you to change the name of the workflow at runtime. This name is displayed in the Workflow Monitoring page.</p>

Data Items

To bind the data items associated with the Start activity, you define pre-activity and post-activity mappings. The pre-activity mappings initialize data in the request form with constants or values retrieved from the flowdata object. The post-activity mappings move form data back into the flowdata object.

Table 10-2 Start Activity Data Item Mappings

Setting	Description
Pre Activity	<p>Allows you to specify one or more pre-activity mappings. When you select this option, you can click a cell in the Source Expression column to specify where the initial request form gets data for a particular target form field.</p> <p>The pre-activity mapping expression is evaluated twice before the form is presented, once during the initial presentation of the form, and again before the post activity to ensure that all the values on the form have a valid type including those that were not initialized. As a result, any calls made to external systems are made twice. For example, a call that retrieves a unique counter for a value makes two calls that allocates two counters, with the last one requested being used.</p> <p>NOTE: ♦ When you select the Pre Activity option, you cannot edit the cells in the Target Form Field column.</p> <ul style="list-style-type: none"> ♦ To make sure the request and approval forms are rendered, while specifying the source expression for the date fields in the Pre-Activity mapping section, you must enter the date in the format given below: <code><YYYY><MM><DD> <time> <GMT offset></code> <p>For example, to specify the date June 1st, 2023, 9.30 AM in the morning (IST,) you must enter it as: <code>2023060109300000+0530</code></p>
Post Activity	<p>Allows you to specify one or more post-activity mappings. When you select this tab, you can click a cell in the Target Expression column to specify where data from a form field should be copied after the form has been processed.</p> <p>NOTE: When you select the Post Activity option, you cannot edit the cells in the Source Form Field column.</p>
MAP ALL	<p>Allows you to generate data from the Pre Activity column, that is stored in a variable, to the Post Activity column.</p>
Source Expression	<p>Specifies a source expression for a pre-activity mapping. When you click a cell in the Source Expression column, the ECMA expression builder appears to help you define your expression.</p>
Target Expression	<p>Specifies a target expression for a post-activity mapping. When you click a cell in the Target Expression column, the ECMA expression builder appears to help you define your expression.</p>

For details on building ECMA expressions, see [Chapter 11, “Working with ECMA Expressions,”](#) on [page 113](#)

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Finish Activity

The Finish activity marks the completion of a workflow. When the Finish activity executes, Workflow Builder sends an email message to notify participants that the workflow has finished.

- ♦ [“Properties” on page 72](#)
- ♦ [“Data Items” on page 72](#)
- ♦ [“Email Template” on page 72](#)
- ♦ [“Problems” on page 74](#)

Properties

The Finish activity includes the following properties:

Table 10-3 *Finish Activity Properties*

Property	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.
Notify by E-Mail	Provides a method of triggering an email notification when you execute the Finish activity. Set the property to “True”, to send email notifications. See “Email Template” on page 72 for information about setting up the email notification.

Data Items

Data items are not supported with this activity.

Email Template

To enable email notification for the Finish activity, you must specify the email template to use, as well as source expressions for target tokens in the email body.

Table 10-4 E-Mail Notification Settings for the Finish Activity

Setting	Description
E-Mail Template	<p>Specifies the name of the email template to use. By default, the Finish activity uses the “Provisioning Approval Completed Notification” template.</p> <p>You can edit an email template from the console. See “Editing an email template:” on page 59 for more information.</p>
Notify	<p>Specifies that this email message is a notification email.</p>
Show Default Tokens	<p>Displays the following default tokens:</p> <ul style="list-style-type: none">◆ TO◆ CC◆ BCC◆ REPLYTO◆ TO_DN◆ CC_DN◆ BCC_DN
Source	<p>Specifies the source expressions for target tokens in the email body.</p>

Setting	Description
Target	<p>The list of target tokens is determined by the selected email template. You cannot add new tokens, but you can assign values to the predefined tokens by building your own source expressions. At runtime, the source expressions are evaluated to determine the value of each token.</p> <p>The available target tokens for the “Provisioning Approval Completed Notification” email template are listed below:</p> <ul style="list-style-type: none"> ◆ TO ◆ CC ◆ BCC ◆ REPLYTO ◆ TO_DN ◆ CC_DN ◆ BCC_DN ◆ requestStatus ◆ requestSubmissionTime ◆ requestID ◆ recipientFullName ◆ initiatorFullName ◆ requestTitle <p>If you use a provisioning request definition template to create your workflow, each token has a default source expression. The default expressions retrieve values from the workflow process (the process object). You can modify these expressions to suit your application requirements.</p> <p>For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113.</p>

NOTE: ◆Email notification is supported only when the **Notify participants by E-Mail** check box is selected on the **Overview** tab, and the **Notify by E-Mail** property for the Approval activity is set to “True”.

- ◆ If you create an activity using any of the target tokens TO_DN, CC_DN, or BCC_DN, you must specify a user’s DN or an expression that resolves to a user’s DN as the source expression for the token.
- ◆ If you create an activity using both the target tokens TO and TO_DN, the workflow sends duplicate notification emails to the target users.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow”](#) on page 60.

Approval Activity

The Approval activity is a user-facing activity that displays an approval form that allows users to approve, deny, or refuse a provisioning request. The Approval activity can have multiple outgoing flow paths, but only one of the paths is executed at runtime.

You can customize the approval form to suit your application requirements. For details on customizing forms, see [Part III, “Working with Forms Catalog,” on page 29](#).

Before displaying the form to the user, the Approval activity performs any pre-activity data mappings specified for the activity.

After the user submits the form, the Approval activity performs any post-activity mappings specified for the activity. These mappings typically include copying data from form fields into the flowdata object.

- ♦ [“Properties” on page 75](#)
- ♦ [“Data Items” on page 80](#)
- ♦ [“Available ECMAScript Methods” on page 81](#)
- ♦ [“Email Template” on page 82](#)
- ♦ [“Specifying the Addressee Property” on page 84](#)
- ♦ [“Problems” on page 89](#)

Properties

The Approval activity includes the following properties:

Table 10-5 Approval Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.
Form	<p>Specifies the name of the approval form to display at runtime. Select the name of the form you want to use, or create a new form. For information on how to create new form using Form Builder, see “Creating New Forms” on page 35.</p> <p>After you select the form, map the data items to include in the form from the listed data items.</p> <p>You must associate a form with a Approval activity. If you do not specify a form an error message appears at runtime.</p>

Property Name	Description
Approver Type	<p>Specifies the number of addresses that are allowed and the approval pattern that is enforced for this activity. The choices are:</p> <ul style="list-style-type: none"> ◆ Normal: Action by the addressee is required to complete the approval. ◆ Group: Action by one addressee in the group is required to complete the approval. ◆ Multiple: Action by all of the addressees is required to complete the approval. You cannot use post-activity data item mapping with this approver Type. ◆ Quorum: Action by a percentage of addressees or an absolute number of addressees is required to complete the approval. You cannot use post-activity data item mapping with this approver Type. <p>For information about how the Approver Type property interacts with the Addressee property, see “Specifying the Addressee Property” on page 84.</p>
Addressee	<p>Specifies a dynamic expression that identifies the addressee for the activity. The addressee is the approver of the workflow.</p> <p>The addressee is determined at runtime, based on the evaluation of the expression. The Workflow Administration Console validates that the expression is a valid ECMA expression. It cannot validate whether the expression resolves to a valid object (such as a role) or whether that object will exist at runtime.</p> <p>For information on specifying addressees, see “Specifying the Addressee Property” on page 84.</p> <p>For more information about developing valid addressee expressions, and about how the Addressee property interacts with the Approver Type property, see “Specifying the Addressee Property” on page 84.</p> <p>TIP: To simplify the process of testing a new workflow, you can set the addressee to be the recipient. Doing so removes the need to log out of the application and log in again as a manager each time you want to test your forms. This technique is useful when the workflow involves multiple levels of approval. After the testing phase is complete, you can change the addressee to the correct value.</p> <p>For details on building ECMA expressions, see “Using the ECMA Expression Builder” on page 114. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>

Property Name	Description
Reminder Start	<p>Specifies a dynamic expression that defines, in milliseconds, the time to send the first reminder email. The start value is an offset from the time of the first assignment associated with the activity. You can pick predefined expressions that represent common intervals (for example, hour, day, week) in the ECMAScript Objects pane of the ECMA expression builder.</p> <p>This property is part of the reminder email function. If this activity is considered important and needs to be acted on quickly, you can configure the activity to send a reminder email to the activity addressee. For example, you can configure the reminder settings to send a reminder email five days before the activity times out, and on a daily basis until the activity times out. To do so, specify a Reminder Start time, a Reminder Interval, and the email to be sent (see “Email Template” on page 82).</p> <p>For details on building ECMA expressions, see “Using the ECMA Expression Builder” on page 114. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>
Reminder Interval	<p>Specifies a dynamic expression that defines the interval between sending reminder emails. You can select predefined expressions that represent common intervals (for example, hour, day, week) in the ECMAScript Objects pane of the ECMA expression builder.</p>
Escalation Addressee	<p>Not available when the approver type is “Multiple” or “Quorum”.</p> <p>Specifies a dynamic expression that identifies the user who should get this task if the timeout limit has been reached.</p> <p>The escalation addressee is determined at runtime, based on how the expression is evaluated.</p> <p>For details on building ECMA expressions, see “Using the ECMA Expression Builder” on page 114. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>
Escalation Count	<p>Not available when the approver type is “Multiple” or “Quorum”.</p> <p>Specifies the number of times to retry the activity in the event of a timeout.</p> <p>When an activity times out, the workflow process can try to complete the activity again, depending on the escalation count specified for the activity. With each retry, the workflow process can escalate the activity to another user. In this case, the activity is reassigned to another user to give this user an opportunity to finish the work of the activity. If the last attempt times out, the activity can be marked as approved, denied, refused, timed out, or in error, depending on the final timeout action specified for the activity.</p>

Property Name	Description
Escalation Interval	<p>Not available when the approver type is “Multiple” or “Quorum”.</p> <p>Specifies a dynamic expression that defines the period of time allotted for the addressee to complete the task. The escalation interval applies each time the addressee executes the activity.</p> <p>The timeout interval (see Timeout in this table) takes precedence over the escalation interval. For example, if you set the Timeout to 10 minutes, and also specify an Escalation Count of 3 minutes and Escalation Interval of 5 minutes, the activity will finish after 10 minutes without attempting all of the retries. In this example, the second retry would be canceled, and the workflow would finish processing for the activity. When the activity completes, the workflow engine follows the link defined by the final timeout action.</p> <p>For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>
Escalation Reminder Start	<p>Not available when the approver type is “Multiple” or “Quorum”.</p> <p>Specifies a dynamic expression that defines the time at which the first reminder email (see Reminder Start in this table) should be sent to the escalation addressee. The start value is an offset from the time of the escalation assignment. You can pick predefined expressions that represent common intervals (for example, hour, day, week) in the ECMA Script Objects pane of the ECMA expression builder.</p>
Escalation Reminder Interval	<p>Not available when the approver type is “Multiple” or “Quorum”.</p> <p>Specifies a dynamic expression that defines how often messages are sent to the escalation addressee after the first escalation reminder is sent. You can select predefined expressions that represent common intervals (for example, hour, day, week) in the ECMA Script Objects pane of the ECMA expression builder.</p>
Final Timeout Action	<p>Determines the final state of the request if the workflow times out. The choices are:</p> <ul style="list-style-type: none"> ◆ Approved ◆ Denied ◆ Refused ◆ Timed Out ◆ Error

Property Name	Description
Timeout	<p>Specifies a dynamic expression that defines the period of time allotted for the addressee to complete the task. The timeout interval applies each time the addressee executes the activity.</p> <p>The timeout setting takes precedence over the escalation count and escalation interval values. If the Timeout setting for the activity is reached before one or more of the escalation attempts have been tried, the activity finishes processing without executing these escalation attempts. For example, if you set the Timeout to 10 minutes, and specify an Escalation Count of 3 minutes and Escalation Interval of 5 minutes, the activity finishes after 10 minutes without attempting all of the escalation attempts. In this example, the second escalation attempt would be canceled, and the workflow would finish processing for the activity. When the activity completes, the workflow engine follows the link defined by the final timeout action.</p> <p>For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>
Timeout Units	<p>Determines the unit of measure used for the timeout interval. The choices are:</p> <ul style="list-style-type: none"> ◆ Milliseconds ◆ Days ◆ Hours ◆ Minutes ◆ Seconds
Exclude Requester	<p>Specifies whether requestors can approve their own provisioning requests.</p> <ul style="list-style-type: none"> ◆ True: The requestor is not allowed to approve their own provisioning requests. ◆ False: The requestor is allowed to approve their own provisioning requests.
Notify by E-Mail	<p>Specifies whether this activity should send email notifications. Set to “True” to notify by email; otherwise, set to False.</p> <p>Specifies the email to send using the Email Template tab (see “Email Template” on page 82).</p> <p>To use this feature, the Notify participants by Email parameter for the provisioning request definition must be set to “True”.</p>
Priority	<p>Specifies a dynamic expression that defines the priority of the approval activity. Valid priority values are 1, 2, or 3. You can also define an expression to determine the priority from workflow data. For example, <code>flowdata.get("Priority")</code>.</p>

Data Items

To bind the data items associated with the Approval activity, define pre-activity and post-activity mappings. The pre-activity mappings initialize data in the approval form with constants, values retrieved from the flowdata object, system process variables, system activity variables, and data retrieved through expression calls to the directory abstraction layer. The post-activity mappings move form data back into the flowdata object.

Table 10-6 Approval Activity Data Item Mappings

Setting	Description
Pre Activity	<p>Allows you to specify one or more pre-activity mappings. When you select this option, you can click a cell in the Source Expression column to specify where the approval form gets data for a particular target form field.</p> <p>The pre-activity mapping expression is evaluated twice before the form is presented, once during the initial presentation of the form and again before the post activity, to ensure that all the values on the form have a valid type including those that were not initialized. As a result, any calls made to external systems are made twice. For example, a call that retrieves a unique counter for a value makes two calls that allocates two counters, with the last one requested being used.</p> <p>NOTE: ♦When you select the Pre Activity option, you cannot edit the cells in the Target Form Field column.</p> <ul style="list-style-type: none">♦ To make sure the request and approval forms are rendered, while specifying the source expression for the date fields in the Pre-Activity mapping section, you must enter the date in the format given below: <YYYY><MM><DD> <time> <GMT offset> <p>For example, to specify the date June 1st, 2023, 9.30 AM in the morning (IST,) you must enter it as:</p> <pre>2023060109300000+0530</pre>
Post Activity	<p>Allows you to specify one or more post-activity mappings. When you select this option, you can click a cell in the Target Expression column to specify where data from a form field should be copied after the form has been processed.</p> <p>You cannot use post-activity mappings with the Multiple and Quorum approver types, see “Properties” on page 75.</p> <p>The form for an Approval activity includes a special internal control called <code>apwaComment</code>. This control causes user comments to be written to the workflow database. It should not have a post-activity mapping.</p> <p>NOTE: When you select the Post Activity option, you cannot edit the cells in the Source Form Field column.</p>
MAP ALL	<p>Allows you to generate data from the Pre Activity column, that is stored in a variable, to the Post Activity column.</p>

Setting	Description
Source Expression	Specifies a source expression for a pre-activity mapping. When you click a cell in the Source Expression column, the ECMA expression builder appears to help you define your expression.
Target Expression	Specifies a target expression for a post-activity mapping. When you click a cell in the Target Expression column, the ECMA expression builder appears to help you define your expression.

For details on building ECMA expressions, see [Chapter 11, “Working with ECMA Expressions,”](#) on page 113.

Available ECMAScript Methods

The Approval activity provides several default methods to use in ECMAScript expressions. Some methods are displayed in the ECMAScript Objects pane of the ECMA expression builder, while others must be entered manually into the text area provided in the ECMA expression builder.

Table 10-7 Available ECMAScript Methods for Approval Activities

Object	Method	Description
Action	<i>Activity-ID.getAction()</i>	Returns the approval action taken by the activity. Possible options are: <ul style="list-style-type: none"> ◆ Approved ◆ Denied ◆ Refused ◆ Timed Out ◆ Error
Addressee	<i>Activity-ID.getAddressee()</i>	Returns the DN of the user who needs to approve or deny the requested action.
Name	<i>Activity-ID.getName(locale)</i>	Returns the name of the approval activity for the specified locale.
Timestamp	<i>Activity-ID.getTimestamp()</i>	Returns the date and time of any approval action taken by the user or system, including approved, denied, refused, timed out, or error.
User	<i>Activity-ID.getUser()</i>	Returns the approver’s DN of the work task for the activity.
WorkId	<i>Activity-ID.getWorkId()</i>	Returns the work item ID for the activity.
Addressee List	<i>Activity-ID.getAddresseeList()</i>	Returns a list of DNs of all users who need to approve or deny the requested action.

Object	Method	Description
Notify Addressee	<i>Activity-</i> <i>ID.getNotifyAddressee()</i>	Returns the full name of the user who needs to approve or deny the requested action.

Email Template

To enable email notification for the Approval activity, you must specify the email template to use, as well as source expressions for target tokens in the email body.

Table 10-8 E-mail Notification Settings for the Approval Activity

Setting	Description
Notify	Specifies that this email notification is a notification email.
Reminder	Specifies that this email notification is a reminder email.
Escalation Reminder	Specifies that this email notification is a retry reminder email.
Show Default Tokens	Displays default tokens (for example, TO, CC, BCC, REPLYTO, TO_DN, CC_DN, and BCC_DN) in the Target column.
E-Mail Template	Specifies the name of the email template to use. By default, the Approval activity uses the "Provisioning Notification template". You can edit an email template in the console. For more information, see "Editing an email template:" on page 59.

Setting	Description
Source/Target	<p data-bbox="794 222 1393 279">Specifies the source expressions for target tokens in the email body.</p> <p data-bbox="794 310 1442 457">The list of target tokens is determined by the selected email template. You cannot add new tokens, but you can assign values to the tokens by building your own source expressions. At runtime, the source expressions are evaluated to determine the value of each token.</p> <p data-bbox="794 489 1268 516">The available target tokens are listed below:</p> <ul data-bbox="818 541 1049 1003" style="list-style-type: none"> ◆ TO ◆ CC ◆ BCC ◆ REPLYTO ◆ TO_DN ◆ CC_DN ◆ BCC_DN ◆ recipientFullName ◆ initiatorFullName ◆ requestTitle ◆ userFirstName <p data-bbox="794 1035 1442 1182">If you use a provisioning request definition template to create your workflow, each token has a default source expression. The default expressions retrieve values from the workflow process (the process object). You can modify these expressions to suit your application requirements.</p> <p data-bbox="794 1213 1417 1268">For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113.</p>

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- NOTE:** ◆Email notification is supported only when the **Notify participants by E-Mail** check box is selected on the **Overview** tab, and the **Notify by E-Mail** property for the Approval activity is set to “True”.
- ◆ When you create a workflow for use with the Resource Request portlet, and you use the “_default_” as the expression for the TO token, the addressee expression must be an ECMA expression.
 - ◆ If you create an activity using any of the target tokens TO_DN, CC_DN, or BCC_DN, you must specify a user’s DN or an expression that resolves to a user’s DN as the source expression for the token.
 - ◆ If you create an activity using both the target tokens TO and TO_DN, the workflow sends duplicate notification emails to the target users.
-

Specifying the Addressee Property

To address an Approval activity, you must enter a valid expression for the **Addressee** property. The addressee is the approver for the activity. The number of approvals that are required to approve the activity is determined by the relationship between the **Addressee** property and the **Approver Type** property, as described in [“Relationship Between Addressee and Approver Type” on page 85](#).

To build the addressee expression:

- 1 Click the plus sign (+) next to **Addressee**, which is available for approver type Group, Multiple, and Quorum.
- 2 Enter the `Internal ID` enclosed in double quotes in the **Addressee** field, then click **Ok**.

NOTE: For each addressee, you must add a separate entry by clicking the plus sign (+), then enter the `Internal ID` separately.

- 3 (Optional) If you want to add a new addressee by using the expression builder, click the plus sign (+) next to **Addressee**, then click the icon in the Edit window next to the **Addressee** field.
 - 3a Choose one of the ECMAScript Objects to build the addressee expression. For example, if you want the addressee to be the recipient’s supervisor and you know the recipient’s internal ID, you can use the `Internal ID` to build the expression, `Entity.get('user', { userIdHere }, 'supervisor')`. Then replace 'userIdHere' with the internal ID of the recipient. At runtime, the internal ID is evaluated and the task is sent to the appropriate approver, in this case, to the supervisor of the recipient.
 - 3b Click **Ok**.
- 4 Enter necessary detail, save and publish the workflow.

NOTE: When the approver type is “Quorum”, you must specify the Quorum Type. At runtime, the Quorum Expression is evaluated and replaced with a meaningful value, whereas for Quorum Constant the value is displayed exactly as entered in the field. For example, if you set the quorum constant value to 50% with four approvers, then at least two approvers are required to approve the request.

Valid Addressee Expressions

An Addressee expression must resolve to one of the following at runtime:

- ♦ A valid individual addressee that can be a user DN, a group DN, or a role DN.
- ♦ A valid list of addressees (for example, created using a Java vector object) that can contain multiple user DNs, multiple group DNs, or multiple role DNs, or a mixture of both.

Because the addressee is the approver, the maximum number of approvals possible equals the number of addressees (the number of user DNs plus the number of group DNs or role DNs) and does not include or count the individual members of a group or roles.

NOTE: A Group DN or a Role DN is always processed to contribute a single vote (that is, when one member of a group or role claims an activity, the rest of the members of the group or role can no longer see or claim the activity), regardless of the approver type.

The following table provides examples of valid addressee expressions that you can create using the ECMA expression builder.

Table 10-9 *Examples of Addressee Expressions*

Type of Expression	Example
Individual user DN	'uniqueUserIdHere '
Individual group DN	'uniqueGroupIdHere '
Individual role DN	'uniqueRoleIdHere '

NOTE: Roles are specific to products.

Relationship Between Addressee and Approver Type

Because the addressee is the approver, the behavior of the workflow and the total number of affirmative approvals needed varies, depending on the type of addressee that is specified by the Addressee expression, and the Approver Type that is selected.

- ◆ [“Normal Approver Type” on page 85](#)
- ◆ [“Group Approver Type” on page 86](#)
- ◆ [“Multiple Approver Type” on page 87](#)
- ◆ [“Quorum Approver Type” on page 88](#)

Normal Approver Type

The following table describes the workflow behavior when different types of addressee are used with the Normal approver type.

Table 10-10 *Workflow Behavior with the Normal Approver Type*

Addressee Value	Description
Individual User DN	<ul style="list-style-type: none"> ◆ Only the user can see the Approval activity in his or her task list. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Group DN	<ul style="list-style-type: none"> ◆ All members of group can see the activity in their task list. ◆ When one member claims the activity, it is removed from the task lists of others in the group. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Role DN	<ul style="list-style-type: none"> ◆ Each member of the role can see the activity in the task list. ◆ When one role member claims the activity, it is removed from the task lists of others in the role. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple User DNs	Not allowed.

Addressee Value	Description
Multiple Group DNs	Not allowed.
Multiple Role DNs	Not allowed.
Mixture of Users, Groups, and Roles	Not allowed.

Group Approver Type

The following table describes the workflow behavior when different types of addressee are used with the Group approver type.

Table 10-11 Workflow Behavior with the Group Approver Type

Addressee Value	Description
Individual User DN	<ul style="list-style-type: none"> ◆ Only the user can see the Approval activity in the task list. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Group DN	<ul style="list-style-type: none"> ◆ All members of group can see the activity in their task lists. ◆ When one member claims the activity, it is removed from the task lists of others in the group. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Role DN	<ul style="list-style-type: none"> ◆ All members of the role can see the activity in their task lists. ◆ When one role member claims the activity, it is removed from the task lists of other members of the role. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple User DNs	<ul style="list-style-type: none"> ◆ All users in the virtual group can see the activity in their task lists. ◆ When one user from the virtual group claims the activity, the activity is removed from the task lists of other users in the group. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple Group DNs	<ul style="list-style-type: none"> ◆ All members in each of the groups can see the activity in their task lists. ◆ When one user from the virtual group claims the activity, the activity is removed from the task lists of others in all the groups. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple Role DNs	<ul style="list-style-type: none"> ◆ Each member of each of the roles can see the activity in the task list. ◆ When one member of one of the roles claims the activity, the activity is removed from the task lists of other members of all the other roles. ◆ Only one approval is needed to complete the activity as “Approved”.
Mixture of Users, Groups, and Roles	<ul style="list-style-type: none"> ◆ All users and members of each group or role can see the activity in their task lists. ◆ When one of the approvers claims the activity, the activity is removed from the task lists of others. ◆ Only one approval is needed to complete the activity as “Approved”.

Multiple Approver Type

The following table describes the workflow behavior when different types of addressees are used with the Multiple approver type.

Table 10-12 *Workflow Behavior with the Multiple Approver Type*

Addressee Value	Description
Individual User DN	<ul style="list-style-type: none"> ◆ Only the user can see the activity in the task list. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Group DN	<ul style="list-style-type: none"> ◆ All members of the group can see the activity in their task lists. ◆ When one member claims the activity, the activity is removed from the task lists of others in the group. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Role DN	<ul style="list-style-type: none"> ◆ All members of the role can see the activity in their task lists. ◆ When one role member claims the activity, the activity is removed from the task lists of other members of the role. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple User DNs	<ul style="list-style-type: none"> ◆ All users can see the activity in their task lists. ◆ All users can claim the activity. ◆ Approval of each user is needed to complete the activity as “Approved”. ◆ Any single denial completes the activity as “Denied”.
Multiple Group DNs	<ul style="list-style-type: none"> ◆ All members of each of the groups can see the activity in their task lists. ◆ When one member of a group claims the activity, the activity is removed from the task lists of others in that group. ◆ Each group must supply one approval to complete the activity as “Approved”. ◆ Any single denial completes the activity as “Denied”.
Multiple Role DNs	<ul style="list-style-type: none"> ◆ All members of each of the roles can see the activity in their task lists. ◆ When one member from a role claims the activity, the activity is removed from the task lists of others in that role. ◆ Each role must supply one approval to complete the activity as “Approved”. ◆ Any single denial completes the activity as “Denied”.
Mixture of Users, Groups, and Roles	<ul style="list-style-type: none"> ◆ Each user and all members of each group or role, can see the activity in their task lists. ◆ Each user can claim the activity. One member of each group or role can claim the activity, after which others in the group or role do not see the task. ◆ Each user and one member of each group or role must approve the activity to complete the activity as “Approved”. ◆ Any single denial completes the activity as “Denied”.

Quorum Approver Type

The following table describes the workflow behavior when different types of addressee are used with the Quorum approver type.

Table 10-13 Workflow Behavior with the Quorum Approver Type

Addressee Value	Description
Individual User DN	<ul style="list-style-type: none"> ◆ Only the user can see the activity in the task list. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Group DN	<ul style="list-style-type: none"> ◆ All members of the group can see the activity in their task lists. ◆ When one member claims the activity, the activity is removed from the task lists of others in the group. ◆ Only one approval is needed to complete the activity as “Approved”.
Individual Role DN	<ul style="list-style-type: none"> ◆ All members of the role can see the activity in their task lists. ◆ When one member claims the activity, the activity is removed from the task lists of other members of the role. ◆ Only one approval is needed to complete the activity as “Approved”.
Multiple User DNs	<ul style="list-style-type: none"> ◆ All users can see the activity in their task lists. ◆ All users can claim the activity simultaneously. ◆ An absolute number, or a specified percentage of addressees, must approve the activity to complete it as “Approved”.
Multiple Group DNs	<ul style="list-style-type: none"> ◆ All members in each group can see the activity in his or her task list. ◆ One member of each group can claim the task, after which others in the group do not see the task. ◆ An absolute number, or a specified percentage of addressees, must approve the activity to complete as “Approved”.
Multiple Role DNs	<ul style="list-style-type: none"> ◆ All members of each role can see the activity in their task lists. ◆ One member of each role can claim the task, after which others in the roles do not see the task. ◆ An absolute number or a specified percentage of addressees, must approve the activity to complete as Approved.
Mixture of Users, Groups, and Roles	<ul style="list-style-type: none"> ◆ Each user and all members of each group or role can see the activity in their task lists. ◆ Each user can claim the activity, and one member of each group or role can claim the activity, after which others in the group do not see the task. ◆ An absolute number, or a specified percentage of addressees, must approve the activity to complete as “Approved”.

Troubleshooting Invalid Addressees

If the expression specified in the **Addressee** property of an Approval activity evaluates to a non-existent DN (for example, if the expression was hard-coded incorrectly, calculated incorrectly, or submitted incorrectly by a user selection), no indication is given that the workflow is not processing normally. The Application Server Console displays a normal forward message, and the Comment and Flow history shows a normal “assigned” message. To avoid this issue, we recommend the following best practices:

1. Use a Condition activity before the Approval activity, and validate the addressee in the Condition activity.
2. For the Approval activity, specify a timeout interval and a link that performs the desired action in case the workflow times out.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Log Activity

The Log activity is a system activity that writes messages to a log. The Workflow Administration Console uses CEF formatted events to log information about the state of a workflow process, and then publishes the log to the audit server.

During the course of its processing, a workflow can log information about various events that occurred. Users can then use the reporting tools to look at logged data.

Before you can use logging, you must enable logging in the user application.

NOTE: During the course of workflow execution, many system events are logged that are not controlled by the Log activity. For example, the Workflow Administration Console writes a message to the log whenever a workflow starts or stops, or when it is approved, denied, or refused.

- ♦ [“Properties” on page 89](#)
- ♦ [“Data Items” on page 90](#)
- ♦ [“Email Template” on page 90](#)
- ♦ [“Problems” on page 90](#)

Properties

The Log activity includes the following properties:

Table 10-14 Log Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.
Audit	Specifies whether log messages should be sent. When this property is set to “True”, messages are sent to all log4j channels. When this property is set to False, no log messages are sent.
Author	Defines the author for the message. By default, the author is the initiator of the provisioning request. This field value may not exceed 255 characters.
Message	<p>Specifies an ECMA expression that defines text for the log message. Typically, this text indicates where within the process this Log activity is executed and provides other information that makes the log easy to understand.</p> <p>For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>
Comment	<p>Specifies an ECMA expression that defines text that can be displayed in the user comments. You can use the comment to record the reason for a request, or the completed approval status of request. Some examples include:</p> <pre>"Reason for request: "+ flowdata.get('reason')</pre> <p>or</p> <pre>"Process has been " + flowdata.get('IDM_COMPLETED_APPROVAL_STATUS')</pre>

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Condition Activity

The Condition activity lets you add conditional logic to a workflow. This logic can be used to control what happens when the workflow executes. The Condition activity allows you to define logic as an ECMA expression that evaluates to a boolean value.

Each Condition activity must have two outgoing flow paths, one that handles conditions that evaluate to true and another that handles conditions that evaluate to “false”. Optionally, a third flow path can be added to handle error conditions that occur if the ECMA expression evaluation fails.

- ♦ [“Properties” on page 91](#)
- ♦ [“Data Items” on page 92](#)
- ♦ [“Email Template” on page 92](#)
- ♦ [“Problems” on page 92](#)

Properties

The Condition activity includes the following properties:

Table 10-15 Condition Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.
Condition Expression	<p>Specifies an ECMA expression that returns True or False. The value returned determines which flow path is followed after the activity has finished executing.</p> <p>TIP: If you need to test whether two objects are equal in a conditional expression, you should use the <code>==</code> operator, rather than the <code>equals()</code> method, unless you are certain that the objects being compared are Java objects of the same type. For instance, use this expression:</p> <pre>(approval_A.getAction() == "DENIED")</pre> <p>instead of this one:</p> <pre>(approval_A.getAction()).equals("DENIED")</pre> <p>For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113. For descriptions of the system variables available in a workflow, see “Understanding Workflow Data” on page 64.</p>

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Mapping Activity

The Mapping activity allows you to add or manipulate data in a workflow. It evaluates the source expression and saves the result in the target expression of the associated data items. You can use it as a way to combine data from parallel-processed approval forms after their data is moved to flowdata.

For example, in a parallel approval context you might need to collect data from more than one approval form that is dependent on each other or needs to be calculated with each other. To accomplish this, place a Mapping activity after a Merge activity and before any activities that consume the results (for example, Condition, Entity, Provisioning or another Approval activity).

You can also use the Mapping activity to isolate calls to external Java routines that might manipulate data and be resource intensive, thereby not slowing down user-based Approval activities in either their pre-activity or post-activity mapping phase.

- ♦ [“Properties” on page 93](#)
- ♦ [“Data Items” on page 93](#)
- ♦ [“Email Template” on page 93](#)
- ♦ [“Problems” on page 94](#)

Properties

The Mapping activity includes the following properties:

Table 10-16 Mapping Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder generates this value automatically in the <Activity>_<N> format, where <Activity> represents the name of the activity and <N> represents an alphanumeric value that contains seven characters.
Name	Provides a name for the activity.

Data Items

To bind the data items associated with the Mapping activity, define pre-activity and post-activity mappings. The pre-activity mappings initialize data in flowdata with constants, values retrieved from the flowdata object, system process variables, system activity variables, or data retrieved through expression calls to the directory abstraction layer. The post-activity mappings move data into the flowdata object.

Table 10-17 Mapping Activity Data Item Mappings

Setting	Description
Source Expression	Specifies a source expression. When you click a cell in the Source Expression column, the ECMA expression builder displays to help you define your expression. For example, <pre>function list() { s=new java.lang.String(); if (wi.XPath('count(flow-data/groups)') > 0) s="There was a group selected"; return s;}; list();</pre>
Target Expression	Specifies a target expression. When you click a cell in the Target Expression column, the ECMA expression builder displays to help you define your expressions or you can click the Map All button. An example of a target expression is: <pre>flowdata.testexpression</pre>

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Workflow Status

The Workflow Status activity lets you specify the approval status for a workflow as either approved or denied upon completion. This method overrides the status set in the **Default Completion Status As Approval** parameter provided in the **Overview** tab. However, for workflows that do not contain a Workflow Status activity, the approval status is determined by the latter, that is the **Default Completion Status As Approval** parameter.

- ♦ [“Properties” on page 94](#)
- ♦ [“Data Items” on page 94](#)
- ♦ [“Email Template” on page 94](#)
- ♦ [“Problems” on page 94](#)

Properties

The Workflow Status activity has the following properties:

Table 10-18 Workflow Status Activity Properties

Property	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in Mapping_<N> format, where <N> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.
Workflow Status	Specifies the approval status as Approved or Denied.

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Email Activity

The Email activity provides a way to send an email to interested parties outside of an approval process.

- ◆ [“Properties” on page 95](#)
- ◆ [“Data Items” on page 95](#)
- ◆ [“Email Template” on page 95](#)
- ◆ [“Problems” on page 96](#)

Properties

The Email activity has the following properties:

Table 10-19 Email Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in E-Mail_<N> format, where <N> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.
Notify by Email	<p>Specifies whether this activity should send email notifications. Set to <code>True</code> to notify by email; otherwise, set to <code>False</code>.</p> <p>You must specify the email required to send in the Email Template tab (see Email Template).</p> <p>To use this feature, you must enable the Notify Participants by EMail parameter in the Overview tab for a workflow (see “Editing a Workflow” on page 46).</p>

Data Items

Data items are not supported with this activity.

Email Template

To enable email notification for this activity, you need to specify the email template to use, as well as source expressions for target tokens in the email body.

Table 10-20 Email Template Settings for the Email Activity

Setting	Description
Notify	Specifies that this email template is a notification email.
Show Default Tokens	Displays system tokens (for example, TO, CC, BCC, REPLYTO, TO_DN, CC_DN, and BCC_DN) provided by default in the Target column.

Setting	Description
List of email templates	<p>By default, the Email Activity has no template selected. You must select the email template to use.</p> <p>You can edit an email template on the Notification Templates page (Catalog > Notification Templates). For more information, see “Editing a Notification Template” on page 121.</p>
Source/Target	<p>Specifies the source expressions for target tokens in the email body.</p> <p>The list of target tokens is determined by the selected email template. You cannot add new tokens, but you can assign values to the tokens by building your own source expressions. At runtime, source expressions are evaluated to determine the value of each token. For details on building ECMA expressions, see Chapter 11, “Working with ECMA Expressions,” on page 113.</p> <p>The available default tokens are listed below:</p> <ul style="list-style-type: none"> ◆ TO <p>To specify multiple recipients, use the following syntax:</p> <pre>'mail1@domain1.com mail2@domain1.com'</pre> <ul style="list-style-type: none"> ◆ CC ◆ BCC ◆ REPLYTO ◆ TO_DN ◆ CC_DN ◆ BCC_DN

- NOTE:** ◆Email notification is supported only when the **Notify participants By EMail** check box is selected in the **Overview** tab, and the **Notify by Email** property for the activity is set to **True**.
- ◆ If you create an activity using any of the target tokens **TO_DN**, **CC_DN**, or **BCC_DN**, you must specify a user’s DN or an expression that resolves to a user’s DN as the source expression for the token.
 - ◆ If you create an activity using both the target tokens **TO** and **TO_DN**, the workflow sends out duplicate notification emails to the target users.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Rest Activity

The Rest activity enables users to call REST endpoints or resources when processing workflow data. The activity allows workflows to exchange data with arbitrary REST services. Data sent to a REST service can integrate a workflow with other systems inside and outside the organization. Data received from a REST service can provide decision support information on approval forms. You create flowdata variables to move data between the workflow and the REST service.

- ◆ “Properties” on page 97
- ◆ “Data Items” on page 101
- ◆ “Email Template” on page 101
- ◆ “Problems” on page 101

Properties

The Rest activity has the following properties. Most of the Rest activity properties are ECMAScript expressions, so ensure that you configure each property by clicking the edit icon in the property field to open the expression builder modal window.

Table 10-21 Rest Activity Properties

Property Name	Description
Input properties	
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Rest_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.
API url	Specifies the encoded URL path that the activity uses when calling the REST server. If the path includes any reserved characters, you must URL encode the path. For example, you can use the following sample expression: <code>encodeURIComponent({api_url_path})</code> For more information about URL encoding, see https://en.wikipedia.org/wiki/Percent-encoding .
HTTP method	Specifies the method the activity uses to retrieve data from or modify data on the REST server. The choices are: <ul style="list-style-type: none">◆ get◆ put◆ post◆ delete

Property Name	Description
Authentication type	<p>Specifies the authentication method used by the activity when calling the REST server. You can specify any one of the following:</p> <ul style="list-style-type: none"> ♦ Basic Authentication: Authenticates by providing the user ID and password within an HTTP header. Click the edit icon in the Username and Password properties to define the expressions for the header in the expression builder. <p>In many cases, the REST server expects the header to be in the “Basic Authentication” format. For more information about the “Basic Authentication” format, see https://en.wikipedia.org/wiki/Basic_authentication.</p> <ul style="list-style-type: none"> ♦ OAuth: The activity uses OAuth-based authentication to communicate with the REST server. In the OAuth authorization url property, specify the expression URL to the authorization server that issues the access token. The access token generated by the specified authorization server enables the activity to authenticate future requests. <p>The OAuth protocol provides the following authorization Grant type to obtain the access tokens for accessing the OAuth protected REST endpoints or resources:</p> <ul style="list-style-type: none"> ♦ Client credentials: The activity authenticates through client credentials. Specify the Client Id and Client secret of the registered client. ♦ Resource owner password: The activity authenticates through both client and user credentials. Specify the Client Id, Client secret, Username, and Password for authentication.
Accept Header	<p>Specifies the Accept header that the activity uses when receiving data from the REST server. The Accept header tells the REST server the format in which it should return data. You can specify an acceptable header, such as <code>application/json</code> and <code>application/xml</code>.</p>
Content type	<p>When you use a PUT or POST request to call the REST service, you may need to specify the content type in the payload data. Click the edit icon to specify an expression. The value of this type of expression is normally either <code>application/json</code> or <code>application/xml</code>.</p>
Request Content	<p>When you use a PUT or POST request to call the REST service, you may need to specify the content in the payload data. Click the edit icon to specify an expression for getting the data for a particular REST server input field.</p>
Http Headers	<p>Specifies any additional HTTP headers the activity uses when calling the REST server. Specify both header name and value expressions, as necessary, using quotation marks around each expression.</p>

Property Name	Description
Timeout	Specifies a dynamic expression that defines the period of time, in milliseconds, allotted for the Rest activity to complete. The timeout interval applies each time the activity is executed by the addressee.
Trust Managers	Specifies one or more trust managers used to authenticate the connection to the REST server. The property expression must evaluate to <code>TrustManager</code> , <code>TrustManager []</code> , or <code>List<TrustManager></code> .
	The default choices available in the ECMA expression builder are:
	<ul style="list-style-type: none">◆ Trust All Certs◆ Trust Certs in default keystore◆ Trust Certs in specified keystore

Property Name	Description
Map Output	<p>If the REST service returns data you want to capture, you need to specify the mapping. This is normally the case for most requests.</p> <p>Click Map Output and specify where the data from REST server output field should be copied after the form has been processed. In particular, you can set the expression for Status Code, Content Type, and Response Content, as follows:</p> <ul style="list-style-type: none"> ♦ Status code: The value of this expression is the HTTP status code from the REST call. ♦ Content type: The value of this type of expression is normally either <code>application/json</code> or <code>application/xml</code>, depending on the format of the data the server returns. REST services typically return responses in a JSON format for the majority of requests. ♦ Response content: This type of expression evaluates to a JSON- or XML-formatted string depending on the returned data. REST services typically return a JavaScript Object Notation (JSON) in response to the majority of requests. <p>The Auto map button in the REST activity can be used to map the Status code, Content type, and Response content fields into the flowdata automatically. You can then read these flowdata variables by extracting the fields in a subsequent activity using the Expression Builder's utility functions with either <code>get()</code> or <code>getObject()</code> functions.</p> <p>For example, in a workflow where you have mapped the response returned from the REST call to the <code>flowdata.REST_<N>/content</code>, you can use the <code>get()</code> function in the following expression to retrieve the values of the flowdata variable in a Log activity's Author field:</p> <pre>function parseIt() { //get JSON value var parsedjson = JSON.parse(flowdata.get('Rest_<N>/content')); return parsedjson; }; parseIt();</pre> <p>where, <code>JSON.parse</code> is a utility function in Expression Builder that parses a string into an JavaScript object.</p>

Property Name	Description
	<p>Alternatively, you can use the <code>getObject()</code> function to retrieve a JavaScript object as above. See the following example for one such expression used to retrieve the values of the same flowdata variable in the Message field of a Log activity:</p> <pre>function parseIt() { var responseObject = flowdata.getObject('Rest_<N>/content'); var childNodes = responseObject.get(0).getChildNodes(); for (var i=0; i<childNodes.getLength(); i) { try { var field = childNodes.item(i); var parsedJSON = JSON.parse(String(field.getTextContent())); return parsedJSON; } catch(e) { e.toString(); } } };parseIt();</pre>

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Notify Activity

The Notify activity is added before the Finish activity in a workflow. The Notify activity allows workflows to send the workflow status information and approver’s comments to the consumer application via REST call.

NOTE: To ensure that the system template workflows or a workflow created in the Workflow Administration Console integrates properly in Identity Governance, you must use the source expressions from the IGA default approval workflow while using the [Notify Activity](#).

- ◆ [“Properties” on page 102](#)
- ◆ [“Data Items” on page 102](#)
- ◆ [“Email Template” on page 102](#)
- ◆ [“Problems” on page 103](#)

Properties

The Notify activity has the following properties:

Table 10-22 *Notify Activity Properties*

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Notify_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.

Data Items

To pass the workflow status and comments information to a consumer application, you must specify data items for the notify activity. The source expressions specify how Workflow Builder maps values retrieved from the workflow database to the target attributes, namely workflow status and notify comment in the input message for the consumer application REST endpoint that will be accessed by the Notify activity.

Table 10-23 *Notify Activity Data Item Mappings*

Setting	Description
Source Expression	An expression used to initialize the data items needed by the Notify activity. When you click the edit icon in the Source Expression column, the ECMA expression builder displays to help you define your expression.
Target Field	A read-only field that specifies the target fields for the initialization data specified in the Source Expression.
Data Type	The data type for this data item.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Integration Activity

The Integration activity provides a way to use a Web service to process workflow data. For detailed information about using the Integration activity, see [“Working with Integration Activities” on page 105](#).

- ♦ [“Properties” on page 103](#)
- ♦ [“Data Items” on page 104](#)
- ♦ [“Email Template” on page 105](#)
- ♦ [“Problems” on page 105](#)

Properties

The Integration activity has the following properties.

Table 10-24 Integration Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Integration_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.
WSDL Resource	<p>Specifies a Web Services Description Language (WSDL) file for the Web service to be used in the Integration activity. After it is specified, the WSDL is incorporated into the workflow definition file.</p> <p>When you select a WSDL file, a dialog box is displayed that allows you to select the Web service port type and operation that you want to use in the Integration activity.</p> <p>You can also specify a SOAP endpoint for the Integration activity and configure authentication for the SOAP service. For more information about specifying a WSDL file and configuring the Integration activity, see “Adding an Integration Activity” on page 106.</p>
Timeout	Specifies a dynamic expression that defines the period of time allotted for the Integration activity to complete. The timeout interval applies each time the activity is executed by the addressee.

Property Name	Description
Retry Count	<p>Specifies the number of times to retry the activity in the event of a timeout.</p> <p>When an activity times out, the workflow process can try to complete the activity again, depending on the retry count specified for the activity. If the last retry times out, the activity can be marked as success, fault, error, or timed out, depending on the final timeout action specified for the activity.</p>
Final Timeout Action	<p>Determines the final state of the request in the event that the Integration activity times out. The choices are:</p> <ul style="list-style-type: none"> ◆ Success ◆ Fault ◆ Error ◆ Timedout

Data Items

To bind the data items associated with the Integration activity, you define pre-activity and post-activity mappings. The pre-activity mappings map values retrieved from the flowdata object to attributes in the Input message for the Web service that will be accessed by the Integration activity. The post-activity mappings map the response from the Web service back into the flowdata object. For more information about data item mapping for Integration activities, see [“Moving Data to and from the Integration Activity” on page 107](#).

Table 10-25 Integration Activity Data Item Mappings

Setting	Description
Pre Activity	<p>Allows you to specify one or more pre-activity mappings. When this option is selected, you can click the edit icon in the Source Expression column to specify where the Integration activity gets data for a particular Web service input field.</p> <p>NOTE: When the Pre Activity option is selected, the cells in the Web Service Input Field column are not editable.</p>
Post Activity	<p>Allows you to specify one or more post-activity mappings. When this option is selected, you can click the edit icon in the Target Expression column to specify where data from a Web service output field should be copied after the form has been processed.</p> <p>NOTE: When the Post Activity option is selected, the cells in the Web Service Output Field column are not editable.</p>

Setting	Description
Source Expression	Specifies a source expression. When you click the edit icon in the Source Expression column, the ECMA expression builder displays to help you define your expression. For example, <code>flowdata.get('Start/RequestRate/Country1')</code> for a Web service input, or <code>flowdata.Start/RequestRate/Country1</code> for a Web service output field.
Web Service Input Field	This column displays all of the input fields for the port type and operation specified when the WSDL file was selected. The fields in this column are automatically populated. If you want to remove an input field, click Mapping , expand the nodes of the sample document and deselect any input fields that you want to remove.
Web Service Output Field	This column displays all of the output fields for the port type and operation specified when the WSDL file was selected. The fields in this column are automatically populated. If you want to remove an output field, click Mapping , expand the nodes of the sample document and deselect any output fields that you want to remove.
Mapping	Displays a hierarchical view of the sample document for the inputs to or outputs from the Web service. You can use this feature to deselect input or output fields (by default, all Web service input and output fields are selected).

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Working with Integration Activities

The Integration activity is an activity that allows workflows to exchange data with arbitrary Web services. Data sent to a Web service can integrate an individual workflow with other systems, inside and outside the organization. Data received from a Web service can provide decision support information on approval forms.

You create flowdata variables to move data from the workflow to the Web service for processing. The Integration activity automatically creates an action model for working with a Web service based on a WSDL document that you specify.

An action model is a visual representation of a set of instructions for processing XML documents and communicating with XML data sources. An action model performs all data mapping, data transformation, and data transfer within an Integration activity. You can edit the action model to manipulate data before and after the data is submitted to the Web service. You then map the data from the Integration activity back to flowdata variables for use in the workflow.

Adding an Integration Activity

IMPORTANT: Make sure that you have the same certificate as the Web service from which the WSDL file was obtained. Workflow Service uses this certificate to authenticate the Web service and establish a connection when the workflow is initiated. For more information on how to import the certificate, see [“Adding a Web Service Authentication Certificate to Workflow Service” on page 108.](#)

To add an Integration activity to a workflow:

- 1 Log in to the Workflow Administration Console and navigate to **Catalog > Workflow**.
- 2 Create a new workflow. (see [“Creating a Workflow” on page 45](#)).
- 3 Select the newly created workflow. The workflow opens into the **Workflow Builder** tab.
- 4 Drag an Integration activity from the palette and place it in the desired location in the workflow.
- 5 In the INTEGRATION ACTIVITY properties view, type a name for the activity in the **Name** field.
- 6 Click the edit icon for the **WSDL Resource** property to display a dialog box.
- 7 Browse your file system to locate the WSDL file for the Web service that you want to use. Click the name of the WSDL file, then click **Open**.

A dialog box that allows you to select a port type and operation for the Web service is displayed.

The **Select Port Type** list includes a set of port types supported by the Web service. Each port type supports operations that include the input and output messages of the operation.

This window allows you to specify the SOAP endpoint, the user ID used to access the SOAP endpoint, and the password used to access the SOAP endpoint. These options are all ECMAScript expressions and can be GCV values. Use the ECMA expression builder to configure the expressions you want to use.

NOTE: The **Use new WSDL Generation type** option enables Workflow Builder to build the Integration activity using an XML Interchange action instead of a WS Interchange action. It is recommended that you leave this option selected, because the WSDL parsing is more robust, and the resulting Integration activity does not require the WSDL document be maintained as part of the provisioning request definition and is smaller in size.

- 8 Select a port type from the **Select Port Type** list.
- 9 Select an operation from the **Select Operation** list.
- 10 **If you want to specify a SOAP endpoint**, specify a SOAP endpoint URL, either by selecting the URL from the **Select Soap Service Endpoint Expression** list or by clicking the edit icon and using the ECMA expression builder to configure an expression that resolves to the SOAP endpoint URL.

NOTE: Ensure that you specify the private key in DER format (PKCS8) and without a password. You can convert the private key from PKS12 to PKCS8 format by running an OpenSSL command. For example, `openssl pkcs8 -topk8 -inform PEM -outform DER -in key.pem -nocrypt > key`

- 11 **If you want to use basic authentication for a SOAP endpoint**, complete the following steps:
 - 11a Select **SOAP Service requires Basic Authentication**.
 - 11b In the **User ID Expression** field, click the edit icon and use the ECMA expression builder to specify an expression that resolves to the user ID used to access the SOAP endpoint.
 - 11c In the **Password Expression** field, click the edit icon and use the ECMA expression builder to specify an expression that resolves to the password used to access the SOAP endpoint.
- 12 Click **OK**.

The Integration activity creates an action model based on the WSDL document. You can use the action model at design time to test the input to the Web service, test the response from the Web service, and map and transform data, if necessary, before returning the data to the workflow.

For many Web services, you don't need to concern yourself with the action model. You simply create data item mappings for the Integration activity.
- 13 Specify the **Timeout**, **Retry Count**, and **Final Timeout Action** properties (see ["Integration Activity" on page 103](#)).

Moving Data to and from the Integration Activity

- 1 Create form fields to allow users to provide input to the Web service accessed by the Integration activity (see ["Creating New Forms" on page 35](#)). For example, if you are working with a Web service that provides stock quotes, you need a field for the user to specify a stock symbol.
- 2 To move user input from the form to the workflow, create a flowdata variable in an activity that precedes the Integration activity in the workflow.

For example, if you have created a form field called "symbol" to accept a stock symbol for input to the Web service, you would go to the post-activity data item mapping for the activity associated with the form that contains the **symbol** field, then you would map the **symbol** field to a flowdata variable (for example, flowdata.symbol).
- 3 In the **Workflow Builder** tab, select the Integration activity icon, then select the **Data Items** tab.
- 4 Select **Pre Activity**.

In the **Web Service Input Field** grid, you should see fields that match all of the input fields associated with the port type and operation specified in [Step 8](#) and [Step 9 on page 106](#).

The integration activity automatically selects all of the input field associated with the port type and operation. You can remove the input fields by following this procedure:

- 4a Click **Mapping**.

The **Modal** window is displayed.
- 4b Expand the nodes and deselect any input fields that you want to remove.
- 4c Click **Ok** to return to the **Data Items** tab.

IMPORTANT: The Integration activity does not support multivalued fields. As a result, the Web service response will contain only one value, even if you select an operation with input field that returns multiple values. For example, the `getWorkEntries` operation, which is used to query work entries (activities) and returns a list of `WorkEntry` objects, will only return the first work entity object in the logs.

- 5 For each **Web Service Input Field**, click in the **Source Expression** field, then click the ECMA expression builder button.
The ECMA expression builder is displayed.
- 6 Expand the **flowdata** node in the **ECMAScript Objects** pane of the ECMA expression builder, then double-click the flowdata variable for the user input to the Web service.
- 7 Click **OK** to return to the **Data Item Mapping** view.
- 8 Select **Post Activity**.
In the **Web Service Output Field** grid, you should see fields that match all of the output fields associated with the port type and operation specified in [Step 8](#) and [Step 9 on page 106](#).
- 9 The Integration activity automatically selects all of the output fields associated with the port type and operation. If you want to remove some of the output fields, follow these steps:
 - 9a Click **Mapping**.
The **Sample Document** dialog box is displayed.
 - 9b Expand the nodes of the sample document and deselect any attributes that you want to remove.
 - 9c Click **OK** to return to the **Data Item Mapping** view.
- 10 Click **Map All** to automatically create flowdata variables for each **Web Service Output Field**.
Alternatively, for each **Web Service Output Field**, click in the **Source Expression** field, then click the ECMA expression builder button.
- 11 Expand the **flowdata** node in the **ECMAScript Objects** pane of the ECMA expression builder, then double-click the flowdata variable that will receive data from the Web service.
- 12 If you want to configure the Integration activity to provide more detailed information about any potential SOAP faults that might be encountered during the SOAP call of the activity, select **Fault Maps** in the **Data Item Mapping** view and click **Map All**. If Identity Manager encounters a SOAP fault, the Integration activity executes the fault maps to provide further details.
- 13 Click **OK** to close the ECMA expression builder.
Now you can work in the Integration view to test and refine the interaction with the Web service.

Adding a Web Service Authentication Certificate to Workflow Service

Before adding a WSDL file to the Integration activity, export the certificate from the Web service, import it into the cacerts directory of Workflow Service, and restart Tomcat.

You can use the following keytool command to import the certificate file:

```
/opt/netiq/idm/apps/jdk/jre/bin/keytool -import -alias aliasName -file certFile -keystore /opt/netiq/idm/apps/jdk/jre/lib/security/cacerts
```

- ◆ Replace `aliasName` with a unique name of your choice for this certificate.
- ◆ Replace `certFile` with the name of your certificate file.

For example,

```
/opt/netiq/idm/apps/jdk/jre/bin/keytool -import -alias idm -file  
certfile.cer -keystore /opt/netiq/idm/apps/jdk/jre/lib/security/cacerts
```

Troubleshooting Issues with Integration Activity

The following table lists the issues you might encounter and the suggested actions for working on these issues.

Issue	Suggested Actions
<p>When a workflow with an Integration activity is initiated, Workflow Service tries and fails to authenticate the Web service. The following error is reported in the Catalina log file:</p> <pre data-bbox="282 653 854 835"><m:Message>com.sssw.b2b.rt.GNVException: rt001801:Document I/O error: peer not authenticated;---&gt; nested javax.net.ssl.SSLPeerUnverifiedExcepti on: peer not authenticated</m:Message> </m:FaultInfo></pre>	<p>Ensure that you have the same certificate as the Web service from which the WSDL file was obtained. For instructions on how to import the certificate, see “Adding a Web Service Authentication Certificate to Workflow Service” on page 108.</p>

Issue	Suggested Actions
<p>When using the <code>flowdata.get()</code> method, the Log activity is unable to retrieve data from an Integration activity. This behavior is only seen in a few SOAP endpoints, such as <code>getEngineState</code>, <code>getProcess</code>, and <code>getVersion</code>, as well as the majority of APIs in the roles WSDL file. This issue occurs when the WSDL parser eliminates SOAP return values that are contained in an attribute from the Web service response while copying them to the Integration activity's Web service output fields. As a result, the log activity is unable to retrieve entire data using the <code>flowdata.get()</code> method.</p>	<p>To resolve this issue, you must ensure the following:</p> <ul style="list-style-type: none"> When defining expressions in the Log activity, use the <code>flowdata.getObject()</code> ECMAScript instead of <code>flowdata.get()</code> to retrieve data items from an Integration activity. <p>NOTE: The <code>flowdata.getObject()</code> returns a Java arraylist of DOM nodes.</p> <p>For example, if you want to get the version of the Web service using the <code>getVersion</code> endpoint, you must specify the following ECMA expression in the Log activity's Comment field:</p> <pre>flowdata.getObject('Integration_<N>/Envelope/Body/getVersionResponse/Version').get(0).getAttribute('<name>')</pre> <p>Where, <code><N></code> denotes the unique identifier for the Integration activity.</p> <p><code>.get(0)</code> is the first element for an array list, that is the Version DOM element.</p> <p><code><name></code> is the value of the attribute in the form of a string. For example, major, minor, and revision.</p> <ul style="list-style-type: none"> When mapping the Web service response back into the flowdata object (post-activity mapping) in the Integration activity, make sure that you select the parent fields and deselect all other output fields in the Mapping modal window. <p>For example, for <code>getEngineState</code> endpoint, click Post Activity > Mapping in Data Items tab, and select the <code>getEngineStateResponse</code> and Envelope check boxes.</p>

Subprocess Activity

The Branch and Merge activities are grouped under the Subprocess activity.

The Subprocess activity has the following properties:

Table 10-26 Subprocess Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Activity_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.

Branch Activity

In a workflow that supports parallel processing, the Branch activity allows multiple users to act on different areas of the work item in parallel. After the users have completed their work, the Merge activity synchronizes the incoming branches in the flow.

A workflow can have multiple Branch activities, but each Branch activity must have an associated Merge activity. All flow paths leading out of a Branch activity will execute.

The Branch activity does not support synchronization between the branches while they are executing. Each branch must not depend on data being updated in another branch. The data synchronization is enforced by the Merge activity. After the Merge activity completes, all of the data set in the branches is available.

Properties

The Branch activity has the following properties:

Table 10-27 Branch Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Branch_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

Merge Activity

In a workflow that supports parallel processing, the Merge activity synchronizes the incoming branches in the flow. The Merge activity is used in conjunction with the Branch activity, which allows two users to act on different areas of the work item in parallel. After the users have completed their work, the Merge activity synchronizes the incoming branches.

A workflow can have multiple Branch activities, but each Branch activity must have an associated Merge activity.

Properties

The Merge activity has the following properties:

Table 10-28 Merge Activity Properties

Property Name	Description
Identifier	A unique string value that identifies the activity. Workflow Builder auto-generates this value in <code>Merge_<N></code> format, where <code><N></code> represents an alphanumeric value that contains 7 characters.
Name	Specifies a name for the activity.

Data Items

Data items are not supported with this activity.

Email Template

Email templates are not supported with this activity.

Problems

The **Problems** tab provides details of the errors and warnings associated with the activity in a workflow. For more information about validating workflow activities, see [“Validating a Workflow” on page 60](#).

11 Working with ECMA Expressions

This section provides details on using the ECMA expression builder.

About the ECMA Expression Builder

Workflow Builder incorporates an ECMAScript interpreter and expression editor, which allows you create script expressions that refer to and modify workflow data. For example, you can use scripting to:

- ◆ Create new data items needed in a workflow under the flowdata element.
- ◆ Perform basic string, date, math, relational, concatenation, and logical operations on data.
- ◆ Use expressions for runtime control to:
 - ◆ Modify or override form field labels.
 - ◆ Initialize form field data.
 - ◆ Customize email addresses and content.
 - ◆ Evaluate any past activity data to conditionally follow a workflow path by using the Condition activity.
 - ◆ Write different log messages that are conditionally triggered by using a single Log activity.

NOTE: To define expressions for a workflow, you need to understand how workflow activities are configured. For details on configuring workflow activities, see [Chapter 10, “Workflow Activity Reference,”](#) on page 69.

About ECMAScript

ECMAScript is an object-oriented scripting language for manipulating objects in a host environment (in this case, Workflow Builder). ECMAScript (ECMA-262 and ISO/IEC 16262) is the standards-based scripting language underpinning both JavaScript (Netscape) and JScript (Microsoft). It is designed to complement and extend existing functionality in a host environment such as Workflow Builder’s graphical user interface. As a host environment, Workflow Builder provides ECMAScript access to various objects for processing. ECMAScript in turn provides a Java-like language that can operate on those objects.

The extensibility of ECMAScript, and its powerful string-handling tools (including regular expressions), make it an ideal language to extend the functionality of Workflow Builder.

NOTE: You can find detailed information about ECMAScript at the [European Computer Manufacturers Association \(ECMA\) Web site \(http://www.ecma-international.org\)](http://www.ecma-international.org).

Using the ECMA Expression Builder

Workflow Builder provides access to ECMAScript in various places. You can access the expression builder in the Properties view such as the **Condition Expression** property for a Condition activity or under the **Data Items** tab of an approval activity in the workflow. Click the edit icon to display the ECMA Expression Builder.

About Global Configuration Values Integration

Global configuration values (GCVs) are integrated with the workflow process through the ECMA expression builder. You can add a GCV using the **Advanced** option in the Settings page. For more information, see [“Configure Advanced Settings” on page 24](#).

To access a GCV through the ECMA expression builder, select any GCV from the GCV list. These GCVs are available to you in all activities on the workflow.

VI Working with Email Notification Templates

This section provides an overview of the email notification templates and its usage in the Workflow Administration Console.

NOTE: You must have the appropriate permissions to perform any task on the Notification Templates page in the Workflow Administration Console. To determine your access permissions, contact your administrator.

- ♦ [Chapter 12, “Email Notification Template Overview,” on page 117](#)
- ♦ [Chapter 13, “Setting Up Email Notification Templates,” on page 119](#)

12 Email Notification Template Overview

In a workflow process, an email notification is sent at various points in the course of its execution. The email notification function included in the Workflow Administration Console allows you to send email notifications that notify users of changes in the state of a workflow, tasks that they need to perform, or when a user assigns a workflow activity to a new addressee. You can send an email notification to one or more users.

Workflow Administration Console allows you to create email templates for any user activity, finish activity, and the email activity. You can then associate these templates with the activities in the workflow builder.

When you create a template and include template tokens, you must specify the source expression for the tokens. When an email is sent, the tokens are replaced dynamically with the values defined under data item mapping in the workflow builder.

The Workflow Administration Console also includes eight default templates. You can use them as-is, or customize them for your environment.

13 Setting Up Email Notification Templates

Email notification templates are used to notify approvers of tasks in their queues, inform the initiator that the workflow is done, or update if there is any change in the workflow status. Email notifications are triggered for approval activities, finish activity, and the email activity.

To access the Notification Templates page, click **Catalog > Notification Templates**. For information regarding tasks that you can perform on the Notification Templates page, see the following sections:

- ♦ [“Creating Templates” on page 119](#)
- ♦ [“Editing a Notification Template” on page 121](#)
- ♦ [“Deleting Notification Templates” on page 121](#)
- ♦ [“Managing Notification Templates” on page 121](#)
- ♦ [“Exporting and Importing Templates for Localization” on page 123](#)
- ♦ [“Publishing Templates” on page 124](#)

Creating Templates

You can create notification templates to notify approvers, remind approvers, and escalate if there is any delay in approvals. You can then attach the template to the workflow activity that supports email notifications.

Creating a New Notification Template

To create a new notification template:

- 1 Select **Catalog > Notification Templates**.
- 2 Click the plus sign (+).
- 3 Provide a unique template ID and a template name.

NOTE: The **Template ID** field supports a few special characters. The characters are, underscore (_), “at” sign (@), hyphen (-), period (.), colon (:).

- 4 Select the format.
- 5 In the **Subject** field, type the text for the email subject line.
- 6 In the **Message** box, type the message you want to be displayed in the notification.

NOTE: You can insert tokens in the email subject line and in the message. To do so, click where you want to insert the token, select the token from the **Tokens** box, then click **Insert Token**. For more information, see [“Inserting a Token” on page 120](#).

- 7 Click **CREATE**.

The template is always created in the default language. The default template is sent to recipients when their local language template is not available.

Inserting a Token

Tokens are variables or replacement tags for text such as the user's name. You can use the following tokens in the subject line and message body of the email:

Template tokens

You can insert template tokens while creating a template. When the template is attached to an activity, you must define the source expression for the target tokens in the data item mapping section of Workflow Builder. For example, a template that is used to notify users of password expiry, you include the token `$recipientname$`, you can add the source expression or add a string value, such as 'full name'. So, when the email is sent, the `$recipientname$` token will be dynamically replaced with the full name of the person who is going to receive the notification.

Standard tokens

You can insert standard tokens while creating a template. However, when you attach the template to an activity, the tokens are not displayed in the data item mapping section. The replacement values for these tokens are generated from the back-end. The following standard tokens are available for selection:

- ◆ `$PORT$`
- ◆ `$PROTOCOL$`
- ◆ `$TASKLIST CONTEXT$`
- ◆ `$SECURE_PROTOCOL$`
- ◆ `$HOST$`
- ◆ `$TASK DETAILS$`
- ◆ `$SECURE PORTS$`

System tokens

The system tokens are included in all the templates. These tokens are standard, and once you attach a template to an activity, these tokens are added to the template from Workflow Builder. You must define the source expression for the target tokens in the data item mapping section of Workflow Builder. The following system tokens are available:

- ◆ `TO`
- ◆ `CC`
- ◆ `BCC`
- ◆ `REPLYTO`
- ◆ `TO_DN`
- ◆ `CC_DN`
- ◆ `BCC_DN`

Editing a Notification Template

You can edit a template from its detail page.

- 1 In the Notification Templates page, click the template you want to edit.
- 2 Click **Edit**.

NOTE: If you have localized versions of the template, then click **Edit** for the localized template you want to edit.

- 3 Make your changes, then click **UPDATE**.
- 4 (Optional) If you want to publish the template, click **Publish**.

Deleting Notification Templates

To delete a notification template, on the Notification Templates page, select the check box next to the template that you want to delete, then click **Delete**. You can select multiple templates for bulk deletion. When you delete the default template, it is deleted from the database.

Managing Notification Templates

When you have access to the Notification Templates page you can perform certain activities such as searching, sorting, and customizing columns.

Sorting Templates

The templates are listed by creation date, with the latest template listed first. You can click the sort arrows next to the template **Name** column and sort the columns based on the following:

- ♦ Name and creation date
- ♦ Alphabetical order
- ♦ Ascending or descending order

You can also set the number of rows per page for display by clicking the drop-down list.

Searching for a Template

You can search and filter specific templates. To find a specific template, you can use any one of the following options:

Simple

Enter any template name in the search box.

Filtered

Click **Filter** and select the notification state from the drop-down list:

- ♦ **Published templates:** Displays templates that are published in the database

- ◆ **Published templates with draft changes:** Displays published templates but with additional changes on the templates that are not published
- ◆ **Not published:** Displays templates that are not published

Combined

You can combine the simple search with the filter option to obtain more refined search results. For example, if you are searching for a template that is published with the word “request” in the title, type `request` in the search box and click **Filter**. On the pop-up window, specify the state as **Published**, then click **FILTER**.

To search for a template specific to a language, click the **Default** drop-down list.

Customizing Columns

To customize columns:

- 1 Click **Catalog > Notification Templates**.
- 2 Click **Column Customization**.
- 3 Select the check box next to the columns you want to display. The selected columns are added to the Notification Templates page.

TIP: To choose all columns, select the check box provided near the search field.

- 4 Click the close icon (X).

NOTE: Workflow Administration Console does not retain the customization. The next time you navigate to the Notification Templates page, the default columns are displayed. However, you can choose the default columns from the Settings page. For more information, see [“Column Customization Settings” on page 27](#)

Importing and Exporting Templates

The import option on the Notification Templates page allows you to import templates from a single file, and the export option allows to export templates to a single file. For example, when you want to use a set of templates from another system and do not want to create a new template, you can use the import function.

To import templates:

- 1 Click **Catalog > Notification Templates**.
- 2 Click **Import Templates**.
- 3 Choose the file you want to import.
- 4 Click **SAVE** or **PUBLISH** to save the data in the database.

NOTE: When you publish, the templates are ready to be attached to an workflow activity.

If there are localized versions of the template available for import, then those templates are also imported with the default template.

To export templates:

- 1 Click **Catalog > Notification Templates**.
- 2 Click the check boxes next to the templates you wish to export.
- 3 Click **Export Templates**.
- 4 On the dialogue box, type a file name.
- 5 Click **EXPORT**.

If there are localized templates available for download, then those templates are also downloaded to a single JSON file.

Using System-Defined Templates

The Notification Templates page lists the eight system-defined templates. You can use them as-is, or edit them to change the content and format of the email messages. However, you cannot delete these templates.

The Workflow Administration Console includes the following templates:

- ◆ Provisioning Reminder
- ◆ Provisioning Notification
- ◆ Provisioning Notification Activity
- ◆ Provisioning Approval Completed Notification
- ◆ Email Based Approval Success Notification
- ◆ Email Based Approval Failure Notification
- ◆ Email Based Approval Provisioning Notification
- ◆ Email Based Approval Reminder Notification

Exporting and Importing Templates for Localization

The notification template is, by default, created in the user's default language. However, you can export the localized templates as a zipped file on your local system. After the files are translated you can import the translated files to the application. Use this option, for example, when you have to send the templates to individual localization teams for translation.

The following languages are supported for translation:

- ◆ Danish
- ◆ German
- ◆ English
- ◆ Spanish
- ◆ French
- ◆ Italian
- ◆ Japanese
- ◆ Norwegian

- ◆ Dutch
- ◆ Polish
- ◆ Portuguese
- ◆ Russian
- ◆ Swedish
- ◆ Chinese (China)
- ◆ Chinese (Taiwan)

To export the templates:

- 1 Click **Catalog > Notification Templates**.
- 2 Click the template you want to export.
- 3 Click **Import/Export Localized Templates > Export Templates for Localization**.
- 4 Select the language or languages you wish to localize.
- 5 Click **EXPORT**.

When the templates are exported, the content from the default template is copied to the exported files. However, if there is a template that is already localized, then the content from the localized template is copied to the exported files.

To import the templates:

- 1 Click **Catalog > Notification Templates**.
- 2 Click the template you want to import.
- 3 Click **Import/Export Localized Templates > Import Localized Templates**.
- 4 Choose the translated files from your local system then click **IMPORT**.

You can save the imported files, discard them from your local system, or publish them for future use.

NOTE: Workflow Administration Console displays an error message during import if the file contains invalid data or if you try to upload files which are not part of the localized data.

Deleting Localized Templates

To delete a localization template, select the check box next to the template that you want to delete, then click **Delete**. You can select multiple templates for bulk deletion.

Publishing Templates

You can publish the localized template individually by clicking **Publish**, or you can select the check boxes, and click **PUBLISH ALL**.

Published templates are stored in the database and can be attached to the workflow activity from Workflow Builder.

Once the template is attached to the workflow, you can specify the email address and include the replacement values for the tokens. Before sending the email notification, ensure the following configurations are in place:

- ◆ Outgoing mail server is configured.
- ◆ The **Notify Participants by E-Mail** check box is selected on the **Overview** tab when Workflow Builder is launched
- ◆ The value for the property **Notify By E-Mail** is set to true for the workflow activity where the template is attached

VII

Working with Email Based Approval

This section provides an overview of email based approval, how to set up email based approval, and its usage in the Workflow Administration Console.

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the settings on this page.

- ◆ [Chapter 14, “Email-Based Approval Overview,” on page 129](#)
- ◆ [Chapter 15, “Managing Approvals by Email,” on page 131](#)

14 Email-Based Approval Overview

The Workflow Administration Console allows you to send an email notifying the request reviewer that they need to review a permission request. Each notification includes a message containing all the information a user needs, to make a decision. You can embed the message in the body, or attach it as a separate document. The reviewer can click the appropriate link on the email, or, they can modify the subject line of the email to approve or deny the request.

Email-based approvals also supports digital signatures to ensure authentication of the message content.

15 Managing Approvals by Email

The Workflow Administration Console allows you to send an email notifying the request reviewers that they need to review a permission request. The email notification can include links that can be used for approving, rejecting, reassigning, or returning requests. You can either respond to the request, or assign the request to another approver without logging in to the application.

You can respond or reassign the notification email in the following ways:

- ◆ By clicking the “Approve”, “Reject”, “Reassign”, or “Return” link in the email. When you click one of these links, the application composes a new email with the required subject and allows you to enter comments in the email and send it.
- ◆ By modifying the subject line of the email. However, you must ensure that the keywords “Approve”, “Reject”, “Reassign”, or “Return” along with the alpha-numeric unique code is not changed.

NOTE:

- ◆ If you forward the email to another user, the link for approval, rejection, reassignment, or return does not work.
- ◆ When you reassign a request, you can specify the approver’s email address to whom you want to reassign. In the absence of an email address, the Workflow Administration Console sends the request to your supervisor.
- ◆ You cannot reassign a request to a group for approval.
- ◆ To reply to the notification email, set the “From” address of the request reviewer mail server as same as the incoming mail server.
- ◆ You cannot select email-based approval notification templates for requests that has custom or complex forms associated with the approval activity. A custom or a complex form usually includes mandatory fields or where the approval activity requires data item mapping.

This chapter includes the following sections on email based approval:

- ◆ [“Checklist to Setup Email-Based Approval” on page 131](#)
- ◆ [“Configuring Outgoing Email Settings” on page 133](#)
- ◆ [“Enabling Email Approval and Configuring Incoming Mail Server Properties” on page 135](#)
- ◆ [“Troubleshooting Email-Based Approval Issues” on page 137](#)

Checklist to Setup Email-Based Approval

Before setting up the email-based approval, review the following checklist:

	Checklist Items
<input type="checkbox"/>	1. Ensure that outgoing mail server is configured, for more information, see “Configuring Outgoing Email Settings” on page 133.
<input type="checkbox"/>	2. Choose the Email-Based Approval templates for workflows. For more information, see “Choosing Email-Based Approval Templates for Workflow” on page 132.
<input type="checkbox"/>	3. To receive emails, set up an account on an email server that supports POP3 or IMAP protocol. If you are using a POP3 type of server, the received emails are not marked as ‘read’ in the incoming mailbox.
<input type="checkbox"/>	4. Enable email-based approval and configure incoming mail server properties from the Workflow Administration Console, for information, see “Enabling Email Approval and Configuring Incoming Mail Server Properties” on page 135.
<input type="checkbox"/>	5. (Conditional) If you want to enable email-based approval in a cluster environment, see “Enabling Email-Based Approval on Cluster Environment” on page 132.

Choosing Email-Based Approval Templates for Workflow

You can attach an email notification template for approval activities, the finish activity, and the email activity.

To attach a template to a workflow:

- 1 Select **Catalog > Workflow**.
- 2 Click the workflow name to which you want to associate the template.
- 3 In the Workflow Builder, click the **Overview** tab.
- 4 Select the **Notify Participants By Email** toggle.
- 5 Click the **Workflow Builder** tab.
- 6 Click the workflow activity to which you want to attach the template.
- 7 Select **True** for the option **Notify By E-mail**.
- 8 Click **Email Template** to display the following email options:
 - ◆ **Notify**
 - ◆ **Reminder**
 - ◆ **Escalation Reminder**
- 9 Choose an email option, then select the template **Email Based Approval Provisioning Notification**.
- 10 Enter the source expressions for the required fields based on the selected template.
- 11 Click **Publish**.

Enabling Email-Based Approval on Cluster Environment

Ensure that the outgoing mail server is configured.

On cluster environment, you must specify the IP address or hostname of the ActiveMQ server in `server.xml` file of the nodes in the cluster, which is set to `localhost` by default. Look for the `brokerURL` attribute for the ActiveMQ server in the `server.xml` and replace the `localhost` with the ActiveMQ server IP address or hostname.

If you enable or disable the Email Based Approval (Off/On) or change the incoming mailbox properties, then restart all the cluster nodes for the change to take effect. You must also verify the connection between the mailbox host and other servers.

Configuring Outgoing Email Settings

To configure outgoing email settings, click **Configuration > Email Based Approval** and specify the settings in the Outgoing Email Settings. The outgoing Email Settings tab also allows digital signature settings.

For outgoing email settings you must enable the following fields.

UI Field	Description
Notification Template Host	<p>Specifies the name or IP address for the database instance. For example, <code>myapplication serverServer</code>.</p> <p>This value replaces the <code>\$HOST\$</code> token in the email templates.</p>
Notification Template Port	<p>Specifies the port number of the Tomcat host for the application.</p> <p>This value replaces the <code>\$PORT\$</code> token in the email templates that are used in provisioning request tasks and approval notifications.</p>
Notification Template Secure	<p>Specifies the secure port number of the Tomcat host for the application.</p> <p>This value replaces the <code>\$SECURE_PORT\$</code> token in the email templates that are used in provisioning request tasks and approval notifications.</p>
Notification Template Protocol	<p>Specifies a non-secure protocol, like <code>http</code>, included in the URL when sending the email. This value replaces the <code>\$PROTOCOL\$</code> token in the email templates that are used in provisioning request tasks and approval notifications.</p>
Notification Template Secure Protocol	<p>Specifies the secure protocol, like <code>https</code>, included in the URL when sending the email. This value replaces the <code>\$SECURE_PROTOCOL\$</code> token in the email templates that are used in provisioning request tasks and approval notifications.</p>
Notification SMTP Email From	<p>Specifies the email account that the application uses to send notifications.</p>

UI Field	Description
SMTP Server Name	Specifies the IP address or DNS name of the SMTP email host appended with the port number that the application uses for provisioning emails. For example, smtp.gmail.com:587. Do not use localhost.
Server requires authentication	<p>Specifies whether you want the server to require authentication.</p> <p>If you require authentication, you must also specify the following:</p> <ul style="list-style-type: none"> ◆ Username Specifies the name of a login account for the email server. ◆ Password Specifies the password of an login account for the mail server.
Use SMTP TLS	Specifies whether you want to secure the contents of email messages during transmission between the mail servers.
Email Notification Image Location	Specifies the path to the image that you want to include in email notifications. For example, https://localhost:8543/IDMProv/images.
Sign email	<p>Specifies whether you want to add a digital signature to outgoing messages. If you enable this option, you must also specify the following:</p> <ul style="list-style-type: none"> ◆ Keystore Path Specifies the full path to the keystore (cacerts) file that you want to use for digitally signing an email. You can manually enter the path or browse to the cacerts file. For example, /opt/netiq/idm/apps/jdk/jre/lib/security/cacerts. ◆ Keystore Password Specifies the password for the keystore file. For example, changeit. ◆ Alias of signature key Specifies the alias of the signing key in the keystore. For example, idmapptest. ◆ Signature key password Specifies the password that protects the file containing the signature key. For example, changeit.

Enabling Email Approval and Configuring Incoming Mail Server Properties

After the request reviewer approves, denies, reassigns, or returns a request, the reply is sent to the incoming mail server that is configured.

To configure incoming mail settings, select **Configuration > Email Based Approval**.

NOTE: Before enabling email-based approvals, ensure that you have configured the workflows to support notifications and (optional) digital signatures. For more information see, [“Choosing Email-Based Approval Templates for Workflow” on page 132](#).

For incoming email settings you must configure the following fields.

UI Field	Description
Server Type	Specifies the type of server that you want to use for the incoming email notifications.
Host	Specifies the name or IP address of the incoming mail server.
Email	<p>Specifies the email address that receives the reply messages from users responsible for reviewing permissions requests.</p> <p>If the notification includes action links for approving, denying, reassigning, or returning a request, the Workflow Administration Console automatically populates the To field. Otherwise, users must specify valid email address in this field.</p> <p>NOTE: If you are specifying a service account email ID in this field, ensure the same email ID is not used for any identity.</p>
Authentication Required	<p>Specifies whether the incoming mail server requires authentication. If you enable this setting, you must also specify the following:</p> <ul style="list-style-type: none">◆ User ID Specifies the account required for server authentication. The account for the incoming mail server should be unique and not a duplicate account that might receive the email notifications.◆ Password Specifies the password for the account.

UI Field	Description
Folder	If you select IMAP as the server type, specify the folder in the email system where you want to store the email notifications. The default folder is <code>INBOX</code> . For POP3 servers, you cannot change the folder name.
Enable SSL	Specifies whether you want to use Secure Sockets Layer (SSL) protocol for authentication.
Use default port	Specifies whether the email process uses the default port for the mail server. Otherwise, specify the port number you want to use to connect to the incoming mail server.
Email Content Options	<p>Specifies the type of information that you want to include in the notification:</p> <ul style="list-style-type: none"> ◆ Exclude action links <p>The notification does not include the action links that users can select to approve or deny the request.</p> <p>To act on the request, users can reply to the email, then add the appropriate keyword, such as “Approve” in the subject line. Alternatively, they can log in to the console to complete the task.</p> ◆ Include action links with digital signature <p>The notification includes the action links that users can select to approve, deny, reassign, or return the request. It also requires a digital ID for authenticating the message content.</p> ◆ Include action links without digital signature <p>The notification includes the action links that users can select to approve, deny, reassign, or return the request. The email does not require a digital ID for authenticating the message content.</p>
Polling Interval	Specifies how often you want to poll the incoming mail server for task notifications.
Token Expiration	Specifies the amount of time that each email-based approval will remain in effect. After the token expires, you cannot use that notification to take any action on the task.
Cleanup Interval	Specifies the interval after which the server can clear expired tokens from the database.

UI Field	Description
Approve, Reject, Reassign and Return	Specifies the terminologies used to display as action links in the email. You can select these links to approve, deny, reassign, and return the request. You can modify these terms for all supported languages.
Success Mail Template and Failure Mail Template	<p>Specifies the email templates that you want to use to indicate the result of an action.</p> <p>Success notifications occur after the user successfully approves, denies, reassigns or returns a task. The application sends a failure notification when one of these tasks are not accomplished.</p>
Domain	<p>Specifies the domain of the email. Allows you to configure more than one domain.</p> <p>If you configure a domain, the email address that you specify for reassigning a request must match one of the configured domains, otherwise, the request is not reassigned. If the domain is not configured then the request is reassigned.</p>
Enable Socks Proxy	<p>Specifies whether you want to use a proxy server to process the approval email messages. If you do not enable this setting the server connects directly to the specified inbox.</p> <p>If you enable this setting, you must also specify values for the following parameters:</p> <ul style="list-style-type: none"> ◆ Proxy Host <p>Specifies the name or IP address of the proxy email server.</p> ◆ Proxy Port <p>Specifies the port that you want to use for incoming email to the proxy server.</p> ◆ Authentication Required <p>Specifies whether the proxy server requires authentication for incoming email.</p> <p>If you enable this setting, you must also specify a valid user ID and password for the proxy server.</p>

Troubleshooting Email-Based Approval Issues

You might encounter the following issues while working with email-based approval:

- ◆ **Empty email-based approval token in the request email**

This issue can occur if email-based approval is not enabled. For example, the feature is disabled while using the new email templates in the workflows.

Check the configuration in Workflow Administration Console, and enable the feature.

- ◆ **The application is not acting on emails**

This issue can occur if the incoming mailbox is not connected from the server.

Verify that the incoming mailbox is connected and reachable from the server where it is deployed.

- ◆ **“Approve”, “deny”, “reassign”, “return” links missing from email after configuring email-based approval**

This issue can occur when the email templates are not properly configured.

Make sure the templates are configured correctly. For more information, see [“Choosing Email-Based Approval Templates for Workflow” on page 132](#).

- ◆ **Reviewer cannot compose an email after clicking the “approve”, “deny”, “reassign” or “return” link. Links are not working**

This issue can occur when the default application is not selected to send emails.

Verify that the default email client is configured. For example, Microsoft Outlook.

- ◆ **Email notification is not delivered**

This issue can occur when an error occurs in the connection between the client and the mail server.

Check the logs and determine whether the connection is configured properly, and the mail server is running and accessible.

Verify the authentication details, port, and if Transport Layer Security (TLS) is enabled or disabled.

- ◆ **Java Message Service (JMS) persistent email queue is not initialized properly**

This issue can occur when JMS is not configured correctly.

Perform the following steps.

1. Navigate to the `/opt/netiq/idm/apps/tomcat/conf` folder.
2. Open the `server.xml` file.
3. Add the following resources:

```
<Resource auth="Container" brokerName="LocalActiveMQBroker"
brokerURL="tcp://localhost:61716" description="JMS Connection
Factory" factory="org.apache.activemq.jndi.JNDIReferenceFactory"
name="jms/ConnectionFactory"
type="org.apache.activemq.ActiveMQConnectionFactory" />
```

```
<Resource auth="Container" description="Topic for IdmApps"
factory="org.apache.activemq.jndi.JNDIReferenceFactory"
name="topic/IDMNotificationDurableTopic"
physicalName="WFNotificationDurableTopic"
type="org.apache.activemq.command.ActiveMQTopic" />
```

```
<Resource auth="Container" description="Topic for IdmApps email
based approval"
factory="org.apache.activemq.jndi.JNDIReferenceFactory"
name="topic/EmailBasedApprovalTopic"
physicalName="EmailBasedApprovalTopic"
type="org.apache.activemq.command.ActiveMQTopic" />
```

NOTE: You have to replace localhost with the IP address or hostname where activemq is running.

4. Open the context.xml file and add the following:

```
<ResourceLink global="topic/IDMNotificationDurableTopic"
name="topic/WFNotificationDurableTopic" type="javax.jms.Topic" />
```

```
<ResourceLink global="topic/EmailBasedApprovalTopic" name="topic/
EmailBasedApprovalTopic" type="javax.jms.Topic" />
```

```
<ResourceLink global="jms/ConnectionFactory" name="jms/
ConnectionFactory" type="javax.jms.ConnectionFactory" />
```

5. Navigate to the /opt/netiq/idm/apps/activemq/conf folder.
6. Open the activemq.xml file.
7. Change the TCP port to the one mentioned in server.xml, that is, 61716.

```
<transportConnector name="openwire" uri="tcp://
0.0.0.0:61716?maximumConnections=1000&wireFormat.maxFrameSize=1
04857600"/>.
```

8. Stop and start ActiveMQ.
9. Stop and start Tomcat.

VIII

Configuring Default Settings for Workflow Engine and Cluster

Clustering any application is a critical part for handling the workload and failover scenarios. The Workflow Engine can be clustered in your deployment to overcome the failover scenario and to manage the workload. This can be achieved by running multiple instances of the Workflow Engine at the same time. Each instance is assigned a unique Engine ID whenever a new instance is initiated in the cluster. The Workflow Engine maintains a list of unique IDs and the status of all the clustered instances in the workflow database.

How Clustering Works?

The workflow processes are distributed across all the instances of Workflow Engine to ensure that all instances have roughly the same workload. If one instance fails, all workflow processes running on that engine is automatically re-assigned to a different instance running on the same cluster. Depending on workload, a fresh Workflow Engine instance may also initiate (with a unique Engine ID) and all workflow processes from the failed instance will be re-assigned to the new instance. All these operations happen in the background seamlessly. This ensures that the Workflow Engines are highly available and do not have any downtime, in case of a failure.

16 Configuring Workflow Engine and Cluster Settings

The settings for clustered Workflow Engine instances can be configured and customized to suit your organization's needs. There are default values assigned to each of these settings.

You can configure the settings for all instances of Workflow Engine through the Engine and Cluster Settings page on Workflow Administration Console. For more information, see the following topics:

- ♦ [“Configuring the Workflow Engine Settings” on page 143](#)
- ♦ [“Configuring the Workflow Cluster Settings” on page 145](#)
- ♦ [“Reviewing the Status of Workflow Engines” on page 145](#)
- ♦ [“Deleting an Instance of Workflow Engine” on page 146](#)

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the settings on this page.

Configuring the Workflow Engine Settings

The Workflow Engine settings apply to all the Workflow Engine instances in the cluster. When you modify any of these settings, all Workflow Engine instances that are part of the same cluster will use the modified values.

The following table describes the Workflow Engine settings that you can configure:

Engine Setting	Description
Enable Email Notification	Enables or disables email notifications for the Workflow Engine. Defaults to enabled.
Web Service Activity Timeout (minutes)	Specifies the default Web Service activity timeout. The default value is 50 minutes.
User Activity Timeout (hours, 0 for no timeout)	Specifies the default user activity timeout. The default value is 0 hours, which indicates no timeout.
Completed Process Timeout (day)	Specifies the number of days that a completed process is kept in the workflow database system. The default value is 120 days.
Completed Process Cleanup Interval (hours)	Specifies the time interval at which the Workflow Engine checks for and removes the completed processes from the workflow database. This setting only applies to those processes that have reached the limit specified in the Completed Process Timeout parameter. The default value is 12 hours.

Engine Setting	Description
Pending Process Interval (seconds)	User activities that are executed on an engine which the process is not bound to are put into a pending state. This interval specifies how often to check for pending activities in order to continue their execution. The default value is 30 seconds.
Retry Queue Interval (minutes)	Activities that fail because of suspected database connectivity issues are put on a retry queue. This interval specifies how often the engine attempts to retry these activities. The default value is 15 minutes.
Thread Keep Alive Time (seconds)	If the pool is larger than the minimum size, excess threads that have been idle for more than the keep-alive time will be destroyed. The default value is 5 minutes.
Maximum Engine Shutdown Timeout (minutes)	The engine attempts to shutdown gracefully. When shutting down it stops queuing new activities for execution and attempts to complete any activities already queued. This timeout specifies the maximum time that the engine waits for all queued activities and threads executing activities to complete. If this time is exceeded, the engine halts processing of queued activities and attempts to stop all threads executing activities. The default value is 1 minute.
Maximum Thread Pool Size	The maximum number of threads that the engine uses to execute activities. The default value is 20.
Minimum Thread Pool Size	The minimum number of threads that the engine uses to execute activities. When a thread is requested and fewer than the minimum are in the pool, a new thread will be created even if there are idle threads in the pool. The default value is 10.
Initial Thread Pool Size	Number of pre-started threads in the pool when it is created. The default is 5.
Process Cache Load Factor	The load factor specifies how full the cache is allowed to get before increasing its capacity. If the number of entries in the cache exceeds the product of the load factor multiplied by the current capacity, then the capacity is increased. The default value is 0.75.
Process Cache Initial Capacity	The process cache is backed by a hash map. The capacity is the number of buckets in the hash map. The initial capacity is the number of buckets at the time the cache is created. The default value is 700.
Process Cache Maximum Capacity	Before adding a process to the cache, if the number of processes in the cache equals or exceeds the Process Cache Maximum Capacity, the cache attempts to remove the oldest inactive process from the cache. The maximum capacity is a soft limit, so the number of processes in the cache might exceed the Process Cache Maximum Capacity if there are no inactive processes (only active processes) in the cache. The default value is 500.
Notify Consumer Interval (seconds)	Specifies how many seconds the Workflow Engine must wait before sending any pending approval status notification to a consumer application. This setting is applicable when consumer application such as Identity Governance is in maintenance mode or if it fails to receive the notification. The default value is 300 seconds.

Configuring the Workflow Cluster Settings

The following table describes the workflow cluster settings that you can configure:

Cluster Setting	Description
Heartbeat Interval	<p>Specifies the time interval at which the Workflow Engine sends out a heartbeat signal to indicate that it is active and running in the cluster.</p> <p>If a Workflow Engine crashes and is restarted, its last state in the database will indicate that it is still running. The Workflow Engine therefore uses a heartbeat timer, which sends heartbeats at the specified interval, to determine that it is still running in the cluster. The minimum value for the heartbeat interval is 60 seconds.</p>
Heartbeat Factor	<p>Specifies the factor that is multiplied with the Heartbeat Interval to arrive at the heartbeat timeout. The minimum value for the Heartbeat Factor is 2.</p> <p>The heartbeat timeout is the maximum elapsed time permitted between heartbeats before an engine will be considered timed out.</p>

Reviewing the Status of Workflow Engines

The Workflow Engines State lists all instances of Workflow Engine in the cluster with their engine IDs and current status. At any given time, a Workflow Engine instance will display one of the following statuses:

SHUTDOWN

Indicates that the Workflow Engine has shut down gracefully. This state is determined using the **Maximum Engine Shutdown Timeout** parameter. For more information, see [“Configuring the Workflow Engine Settings” on page 143](#).

TIMEDOUT

Indicates that the Workflow Engine has timed-out. This state is determined by two parameters, namely the **Heartbeat Interval** and **Heartbeat Factor**. For more information, see [“Configuring the Workflow Cluster Settings” on page 145](#).

STARTING

Indicates that the Workflow Engine is starting.

RUNNING

Indicates that the Workflow Engine is active.

Deleting an Instance of Workflow Engine

Review the following guidelines before deleting any instance of a Workflow Engine:

- ◆ You must have appropriate permission to delete a Workflow Engine from the Workflow Administration Console. If you are unable to locate the **Delete** icon under the **Workflow Engines State**, it indicates that you do not have the required permission. For more information, see [“Manage User Access” on page 23](#).
- ◆ You can delete a Workflow Engine only when it is in shutdown state. The **Delete** icon is disabled by default when a Workflow Engine is in starting, running, or timedout state.

To delete an instance of Workflow Engine, expand the **Workflow Engines State** option on the Engine and Cluster Settings page, click the **Delete** icon next to the Engine ID that you want to delete, then click **Confirm**.

NOTE: In the back-end, the application continuously monitors the status of all Workflow Engines in the database. If an instance of Workflow Engine is in the shutdown state for more than 5 minutes, the application automatically deletes that instance from the database. The timer for this automatic engine deletion is set by default, and it cannot be configured.

IX

Understanding Workflow Monitoring

Once a workflow is initiated, you can monitor its progress through the Workflow Administration Console. You can view the current status, reassign activities within the workflow, terminate a workflow process, and even view the comments logged during its execution.

This section include procedures for monitoring, reassigning, and terminating workflow processes running on the Workflow Engine.

17 Monitoring Workflow Processes

The Workflow monitoring page lists all workflow processes initiated by the Workflow Engine. You can use the pagination option to navigate through the workflow process list. If required, you may also change the number of entries to display on each page.

Click the **Refresh** icon to get the latest workflow process list from the workflow runtime database. The status of all running workflow processes also gets refreshed.

You can perform the following operations on the Workflow monitoring page:

- ◆ [“Finding Workflow Processes That Match Search Criteria” on page 149](#)
- ◆ [“Viewing the Status of a Workflow Process” on page 150](#)
- ◆ [“Viewing the Approval Status of a Workflow Process” on page 151](#)
- ◆ [“Actions You Can Perform On The Page” on page 152](#)

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the settings on this page.

Finding Workflow Processes That Match Search Criteria

To find a specific workflow process, you can use any of the following options:

Simple Search

Enter the name of the workflow process, recipient, or requester in the search bar.

NOTE: The name of a workflow process is determined by the workflow’s **Start Activity** and its two properties, namely **Resource Name Override Type** and **Resource Name Override**. When the **Resource Name Override Type** is a **Constant**, the name provided in the **Resource Name Override** is the process name. However, if the type is an expression, the Workflow Engine evaluates the expression defined in the **Resource Name Override** and generates a meaningful process name at runtime.

Filtered Search

To filter the search for workflow processes, click the **Filter** icon and use one of the following options:

- ◆ Name of the requester who initiated the workflow process
- ◆ Name of the recipient
- ◆ Status of the workflow process
- ◆ Status of the approval activity
- ◆ Requested date. You can filter the workflow processes either before or after a particular date

NOTE: After selecting a date and time from the calendar, click any place outside the calendar to close it.

Sorting Workflow Processes by Recipient, Requester, or Request Date

By default, the workflow process list on the Workflow monitoring page is sorted based on the **Request Date** column, displaying the most recently requested process on top of the list. You can also sort the list based on the names of the requester or recipient. Click the **sort** icon next to these columns to arrange the list alphabetically. Subsequently, you can shuffle the list in ascending or descending order by clicking the **sort** icon.

Customizing the Columns

You can choose the columns to display on the Workflow monitoring page using the **Column Customization** option.

To customize the columns:

- 1 Click the **Column Customization** icon.
- 2 Select the check box next to the desired column that you want to display. The selected columns are added simultaneously to the Workflow monitoring page.

TIP: To choose all columns, select the check box provided near the search field.

- 3 Click the close sign (x) on the **Column Customization** window.

NOTE: Workflow Administration Console does not save your customization. Next time when you navigate to the Workflow monitoring page, columns that are configured to display by default will be shown. Alternatively, if you have appropriate permissions, you can set your preferences as default from the Settings page. For more information, see [“Column Customization Settings” on page 27](#).

Viewing the Status of a Workflow Process

At any given time, a workflow process will display one of the following statuses in the **Status** column:

Running

Indicates that a workflow process is in progress. One or more approval request activities is waiting for an action from the approver.

Completed

Indicates that a workflow process is complete. You can view the approval status in the **Approval Status** column. To know more about the different states of approval, see [Viewing the Approval Status of a Workflow Process](#).

Stopped

(Applies to a non-clustered Workflow Engine environment) Indicates that instance of the workflow engine is currently down and not reachable.

Terminated

Indicates that a workflow process was terminated before completion.

Viewing the Approval Status of a Workflow Process

The **Approval Status** column reflects the current approval status of a workflow process. At any given time, a workflow process will display one of the following statuses:

Processing

Indicates that one or more activities in the workflow process is waiting for an action from the approver. For example, if a workflow process has two approval activities defined, one is already approved, and the other is still waiting for approval. Technically, the workflow process is still running, so the workflow process displays the approval status as `Processing`.

Approved

Indicates that all approval activities in the workflow process have been completed.

Denied

Indicates that one or more approval activities in the workflow process was rejected by the approver.

Retracted

Indicates that the request for permission access was retracted by the requester. In this case, the workflow process is terminated before completion. Occasionally, when a user retracts a request with a pending workflow approval task, the approval task might continue to display on the application used to request access, such as Identity Governance, even though the status of the workflow changes to `Terminated` on the Workflow Administration Console. The delay occurs because the scheduler responsible for deleting the data runs as per the interval specified in the Pending Process Interval field on the Engine and Cluster configuration page. The default interval is 30 seconds for optimal performance. Optionally, reset the value to less than 30 seconds by accessing [Configuration > Engine and Cluster](#). For more information, see [Configuring Workflow Engine and Cluster settings](#). In SaaS environments, contact your SaaS Operations Administrator to reset the value.

Error

Indicates that one or more approval activities in the workflow process is faulty. In this case, the entire workflow process is terminated before completion. The errors can occur due to many reasons, some of them are listed below:

- ◆ Error in calling the token end point.
- ◆ Error while initializing the scripting engine or scripting context.
- ◆ While forwarding a task, the Activity ID or Addressee details are missing or empty.

Actions You Can Perform On The Page

Workflow Administration Console allows you to manage workflow processes through the following actions:

- ♦ [Terminating a Workflow Process](#)
- ♦ [Reassigning a Workflow Process](#)
- ♦ [Viewing Workflow Process Comments](#)

IMPORTANT: You must have appropriate permission to reassign or terminate a workflow process. If you are unable to view or perform these actions, contact your administrator for assistance.

Terminating a Workflow Process

You can terminate a workflow process if you do not want to continue its processing. While terminating, you must provide a reason explaining why you want to terminate that workflow process. After termination, all activities associated with that workflow process will end, and the workflow status will change to `Terminated`.

NOTE: While initiating a workflow process, if the Workflow Engine detects an error in the workflow definition, it automatically terminates that workflow process.

You can terminate a running workflow process in the following scenarios:

- ♦ When an activity that is open for a long duration, is preventing the completion of the workflow process.
- ♦ When a user has retracted the request for permission access.
- ♦ When a workflow process has stopped and cannot be restarted.

To terminate a workflow process:

- 1 On the Workflow monitoring page, identify a workflow process that you want to terminate and select the check box next to its name. You can also select multiple check boxes for terminating more than one workflow process at a time.

NOTE: The check box is automatically disabled for a workflow process that is in terminated or completed state.

- 2 Click the **Terminate workflows** icon.
- 3 Specify a reason for terminating the workflow process.
- 4 Click **Terminate**.

Reassigning a Workflow Process

Sometimes, the activities that have been assigned to an individual may require to be reassigned to someone else. You can assign one or more activities associated with a workflow process to another addressee in the organization. While reassigning, you must also provide a reason explaining why you want to reassign that activity. When the activity is reassigned, the Workflow Engine notifies the recipient about the task through an e-mail.

You must review the following guidelines before reassigning a workflow process:

- ◆ Reassign a workflow process only if an approval request activity has timed-out or is unattended for a long time. This might happen when either the recipient is unavailable or has left the organization.
- ◆ You can reassign a workflow process that has stopped and cannot be restarted.

To reassign a workflow process:

- 1 On the Workflow monitoring page, identify a workflow process that you want to reassign, then click the **Reassign** icon.
- 2 In the modal window, select the check box next to the workflow activity that you want to reassign.

NOTE: ◆ You can reassign only one workflow process at a time. However, if a workflow process has more than one activity, you can either select all activities or choose only those activities that you want to reassign.

- ◆ Before re-assigning any activity, refer to its status in the **Status** column. For more information on the different types of status and its description, see [“Viewing the Approval Status of a Workflow Process” on page 151](#).

-
- 3 Click the **Reassign To** drop-down menu and select the addressee that you want to reassign the task to.
 - 4 Specify a reason for reassignment in the **Comment** text box.
 - 5 Click **Reassign**.

Viewing Workflow Process Comments

When a workflow process is executing, the Workflow Engine logs the key events in form of comments. This includes comments logged by the system and the user. System comments corresponds to the actions taken by the application to complete the workflow process. For example, assigning the approval activity to an individual who can approve the request. User comments, on the other hand, are the comments that a user adds with each action. For example, the reason provided by an administrator while terminating a workflow process.

You can review the comments using the **View Comments** option provided in the **Actions** tab on the Workflow monitoring page. The events are listed in reverse chronological order with the latest event on top. Each event includes a comment with a timestamp, a reference to the activity name, and indicates whether the comment was system-generated or user-defined. By default, the comments added by a user is displayed. To view both the system and user comments, click the **View System Comments** check box.

The **View Comments** feature provides visibility into workflow execution. If the Workflow Engine terminates a workflow process with an error, the administrator can easily trace the error details from the workflow comments window.

X Understanding and Setting Up Event Logging

Logging is the main tool you use for debugging the Workflow Administration configuration. The logging service provides facilities for writing, viewing, filtering, and listening for log messages. The Tomcat application server instances and subsystems, and applications that run on Tomcat or in client JVMs generate these log messages.

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the settings on this page.

This sections discusses the following topics:

- ♦ [Chapter 18, “Understanding the Basics of Logging,” on page 157](#)
- ♦ [Chapter 19, “Configuring Logging,” on page 169](#)
- ♦ [Chapter 20, “Configuring Logging in a Cluster,” on page 175](#)

18 Understanding the Basics of Logging

Logging is used to debug the configurations for the various features in the Workflow Administration Console. The logging service allows you to easily write, view, filter, and listen to log messages. Workflow Administration Console log levels are set for features, and each feature is mapped to a set of packages. Changing the log level for a feature resets the log levels for all the packages. These changes can then be persisted and saved in the database. The Workflow Administration Console also includes the option to add miscellaneous packages.

This section discusses the following topics:

- ♦ [“About Logging Services” on page 157](#)
- ♦ [“What Can Be Logged” on page 162](#)
- ♦ [“The Workflow Logging Environment and Process” on page 162](#)
- ♦ [“Types of Log Files” on page 164](#)
- ♦ [“Understanding the Log Format” on page 165](#)

About Logging Services

A Tomcat server uses logging services to communicate its status and respond to specific events, including server startup and shutdown information, failures of one or more subsystems, errors, warning messages, access information on HTTP requests, and additional information. For example, you can use the logging services from Tomcat to report error conditions, or to listen for log messages from a specific subsystem.

All administrator and end-user actions and events are logged to the Tomcat server console and to the Tomcat server log file which allows easy access to this information for security and operational purposes. Additionally, the audit log system provides the ability to monitor ongoing activities such as authentication activity and up time of the system. File logging is enabled by default.

The workflow functionalities are implemented in a layered architecture. Each feature uses one or more packages. Each package handles a specific area of a feature and has its own independent log level that obtains event messages from different parts of the application. The logs contain information about processing and interactions among components that occur while fulfilling user and administrative requests, and during general system processing. By enabling the correct log levels for various features, an administrator can monitor how the workflow service processes user and administrative requests. Package names are based on Java Development Kit (JDK) conventions. The event messages include these package names indicating the context of the message output. The logs include tags and values that allow the administrator to identify and correlate which package log entries pertain to a given transaction and user. [Table 18-1](#) describes some of the features and the packages they use.

Table 18-1 Workflow Administration Packages and Features

Feature	Description	Packages
Approval	The approval packages are implemented for approving any permission or other user request.	<ul style="list-style-type: none">◆ com.netiq.idm.rest.access.util◆ com.netiq.workflow.access.nodes◆ com.novell.soa.af◆ com.novell.soa.af.impl.worklist◆ com.novell.soa.af.rest.controller◆ com.novell.srvprv.apwa.util
Audit and Logging	Logging allows you to debug the configurations associated with the various features in the Workflow Administration Console. The logging service allows to write, view, filter, and listen to log messages. You can configure logging to troubleshoot errors, or to receive notification for specific events. These events are logged in CEF format.	<ul style="list-style-type: none">◆ com.microfocus.logging.controller◆ com.microfocus.logging.dao◆ com.microfocus.logging.serviceImpl◆ com.netiq.idm.logging.cache◆ com.netiq.idm.logging.syslog◆ com.novell.soa.af.impl◆ com.novell.soa.af.logging◆ com.sssw.fw.event.impl
Authorization	The Settings page in the Workflow Administration Console is used to assign trustees, configure the display settings, and categories, and process types for the workflow catalog.	<ul style="list-style-type: none">◆ com.microfocus.authorization.controller◆ com.microfocus.authorization.persist◆ com.microfocus.external.auth◆ com.microfocus.workflow.store.auth◆ com.microfocus.external.auth.oauth◆ com.netiq.idm.auth.oauth◆ com.microfocus.common.auth.filter◆ com.novell.common.auth.sso

Feature	Description	Packages
Common	The common packages are common to more than one feature in the workflow service.	<ul style="list-style-type: none"> ◆ com.microfocus.soa.af.data.migration ◆ com.novell.common ◆ com.novell.soa.af.metrics.impl ◆ com.novell.soa.af.metrics.soap ◆ com.novell.soa.af.rest.controller ◆ com.microfocus.workflow.store.builder.controller ◆ com.microfocus.workflow.store.controllers ◆ com.microfocus.workflow.store.rest.util ◆ com.novell.soa.af.util ◆ com.novell.soa.common.i18n ◆ com.novell.soa.throttle ◆ com.novell.soa.util ◆ com.novell.srvprv.apwa.util ◆ com.novell.srvprv.impl.security ◆ com.novell.srvprv.impl.service ◆ com.novell.srvprv.spi.security ◆ com.sssw.fw.security.core ◆ com.sssw.fw.util ◆ com.microfocus.user.service ◆ com.microfocus.util ◆ com.microfocus.bpmn.conversion.parser ◆ com.microfocus.bpmn.conversion.visitor ◆ com.microfocus.user.controllers
Configuration	In the Workflow Administration Console, the Configuration tab is used to configure the logging, email based approval, and engine and cluster settings.	<ul style="list-style-type: none"> ◆ com.microfocus.soa.config ◆ com.sssw.fw.core ◆ com.sssw.portal.servlet
Dashboard	The Dashboard is used to monitor the status of workflows and review their performance all in one place. The Dashboard also helps in tracking and prioritizing the workflows based on the need of the organization.	<ul style="list-style-type: none"> ◆ com.microfocus.dashboard.controller ◆ com.microfocus.dashboard.dao ◆ com.microfocus.dashboard.metrics.impl

Feature	Description	Packages
Data Layer	It is the layer that interacts with the persistent store, such as, the database to fetch any information.	<ul style="list-style-type: none"> ◆ com.microfocus.soa.af.data ◆ com.microfocus.soa.af.data.handler ◆ com.microfocus.soa.af.data.idm ◆ com.microfocus.soa.af.data.ig ◆ com.microfocus.soa.af.data.script ◆ com.microfocus.soa.identity.util ◆ com.novell.idm.nrf.persist ◆ com.novell.idm.nrf.service ◆ com.novell.idm.nrf.util ◆ com.novell.soa.af.impl.persist ◆ com.novell.soa.persist ◆ com.novell.srvprv.impl.servlet.service ◆ com.novell.srvprv.impl.vdata.definition ◆ com.novell.srvprv.impl.vdata.model ◆ com.novell.srvprv.impl.vdata.model.util ◆ com.novell.srvprv.spi.vdata.util ◆ com.sssw.fw.directory.api ◆ com.sssw.fw.directory.core ◆ com.sssw.fw.directory.persist ◆ com.sssw.fw.directory.realm.impl.jndildap ◆ com.sssw.fw.util.jndi
Email-based Approval	Email notifications in the Workflow Administration Console informs users of tasks and events in the system. For example, sending an email to approvers when an event or task requires an approval.	<ul style="list-style-type: none"> ◆ com.novell.srvprv.spi.email ◆ com.novell.soa.af.impl.emailapproval ◆ com.novell.soa.af.rest.controller ◆ com.novell.soa.notification.mailbox ◆ com.novell.soa.notification.mailbox.impl
Engine and Cluster	Provides information on engine and cluster.	<ul style="list-style-type: none"> ◆ com.novell.soa.af.impl.core ◆ com.sssw.fw.cachemgr.cluster ◆ com.sssw.fw.cachemgr.core

Feature	Description	Packages
External Service	Implements the client to connect to the external services, such as Identity Governance and Identity Manager.	<ul style="list-style-type: none"> ◆ com.microfocus.external.client ◆ com.microfocus.external.idm ◆ com.microfocus.external.ig ◆ com.microfocus.external.igaworkflow.impl ◆ com.microfocus.external.nodes ◆ com.microfocus.idm.nrf.persist ◆ com.microfocus.idm.nrf.service ◆ com.microfocus.idm.nrf.util
Locale	Includes information on all default and supported locales.	com.microfocus.rest
Notification	The notification function included in the Workflow Administration Console allows you to send email notifications that notify users of changes in the state of a workflow, tasks that they need to perform, or when a user assigns a workflow activity to a new addressee.	<ul style="list-style-type: none"> ◆ com.novell.soa.af.impl.core ◆ com.novell.soa.notification ◆ com.novell.soa.notification.impl ◆ com.novell.soa.notification.impl.jms ◆ com.novell.soa.notification.impl.vdx
Workflow Process	Includes information on workflow processes, such as start, approval, finish.	<ul style="list-style-type: none"> ◆ com.novell.soa.af.impl.activity ◆ com.novell.soa.af.impl.core ◆ com.novell.soa.af.impl.link ◆ com.novell.soa.af.impl.model ◆ com.novell.soa.af.impl.prvsrv ◆ com.novell.soa.af.impl.scripting ◆ com.novell.soa.af.impl.scripting.bridge.service ◆ com.novell.soa.af.impl.timers ◆ com.novell.soa.script.impl.dom.impl ◆ com.novell.soa.script.impl.lang.es.impl ◆ com.novell.srvprv.impl.servlet

The generated logs that are primarily intended for debugging the software. System administrators and support personnel can identify and isolate problems caused by configuration errors, invalid user data, or network problems. However, component file logging is typically the first step in identifying software bugs.

Package logging is more verbose than audit logging. It increases the processing load. On a day-to-day basis, you should enable only log levels of error conditions and system warnings. If a specific problem occurs, logging can be set to **Info** or **Debug** to gather extra information needed to isolate and resolve the detected problem. When the problem is resolved, logging should be reconfigured to log only error conditions and system warnings.

What Can Be Logged

The Workflow Administration Console allows you to log any workflow functionality, and actions, such as granting permissions and making external service calls. The log level for these features is controlled by configuring logging for the packages they use. You can change log levels from the Logging page.

The Workflow Administration Console functionality that executes on a client and does not directly execute in context of the web server cannot be logged in the same way. For example, most of the form processing that occurs in the client. The action scripts defined on the form control's `onLoad`, `onChange`, or custom events execute in the browser of the user's client computer and not in the workflow web server. Therefore, errors that occur while rendering the form or processing an action script, cannot be directly logged. However, workflow queries issued from a form or Start Activity can be logged to troubleshoot the workflow features. You can view the Workflow Administration Console errors and informational messages in the Client Browser Developer Tool. Click either the **Console** tab or the **Network** tab. It contains HTTP response codes for both successful and failed requests. The workflow application allow you to record the outcome of a user's request and response.

The Workflow Administration Console allows you to log the state of a user's request and response at the following locations in the data flow:

- ◆ Between the browser and the application server
- ◆ Between the application server and the application database
- ◆ Between the application server and the external service

You can configure the log files to include entries for the following events:

- ◆ Configuration
- ◆ Events processed by application components such as authentication, role assignment, and resource access
- ◆ Error conditions

The log files help you determine the reason for a request failure. For example, if the browser did not send the required information.

The Workflow Logging Environment and Process

The following sections describes the workflow logging environment, and provides an overview of the logging process.

Terminology

The logging framework comprises of three main components: loggers, appenders, and layouts. These components work together to accomplish the following tasks:

- ◆ Record messages based on message type and level.
- ◆ Control how log messages are formatted and where they are reported at runtime.

Logger:

A logger is a named entity. A logger object records messages for a specific subsystem or on the application components. An application can create multiple loggers, each with a unique name. Typically, an application creates a logger instance for each application class that will emit log messages. Logger names are case-sensitive, and follow the Java package dot notation naming convention.

All loggers specific to the workflow are defined in the `workflow_logging.xml` file. You can set the severity level for each logger at any level in the hierarchy by editing the `workflow_logging.xml` file. For more information, see [“Specifying the Severity Level for Commons Logging API Loggers” on page 170](#).

Appender:

The logging configuration file defines appenders to represent destinations for logging output. You can define multiple appenders. For example, an application might define one appender that sends log messages to standard output, and another appender that writes log messages to a file. Additionally, you can configure individual loggers to write to zero or more appenders. For example, you can configure the loggers to send all logging messages to a log file, but only Error level messages to standard output. Workflow provides a full suite of appenders offered by the logging configuration file.

The console and file appenders are defined in the `workflow_logging.xml` file.

Layout:

The logging configuration file defines layouts to control the format of log messages. Each layout specifies a particular message format. A specific layout is associated with each appender, which allows you to specify a different log message format for standard output than for file output, if required.

Components for Logging

A logging system includes the following basic components:

- ♦ A component that produces log messages
- ♦ A component that distributes (publishes) log messages

By default, Tomcat supports Java-based logging to distribute messages. The `LoggingHelper` class provides access to the `java.util.logging.Logger` object used for server logging. The Java Logging APIs can be used to add custom handlers, filters, and formatters.

How Logging Works

The workflow service supports logging by using a custom logging framework. In this environment, Tomcat subsystems and workflow components send log requests to the logger objects. The logger objects then assign logrecord objects, which are passed to appender objects for publication. By default, the logger objects log messages to the system console and to the Tomcat server log file with a logging level of Info and above. Events are logged to all activated loggers.

- ♦ The Tomcat server’s log messages are directed to `catalina.out` and `idapps.out`.
- ♦ OSP log messages are directed to `osp.out`.

Custom appenders are created to handle log messages to convert the messages to a specific format, then send them to the configured auditing service.

To configure logging, see [“Configuring Logging” on page 169](#).

Types of Log Files

This section discusses the different log files that are generated and what each file contains.

Catalina Log

The Catalina log is the global log. It records information about events such as the startup and shutdown of the Tomcat application server, the deployment of new applications, or the failure of one or more subsystems. The messages include information about the time and date of the event and the ID of the user who initiated the event.

The `catalina.log` file contains all log messages that are written to the Tomcat `system.out` and `system.err` streams. Tomcat internal log statements use the `java.util.logging` package (`juli`). The default destination for that log is `standard.out`.

The `catalina.out` file can include:

Uncaught exceptions printed by `java.lang.ThreadGroup.uncaughtException(..)`

Thread dumps, if you requested them through a system signal

The `catalina.out` file is located on the Tomcat server instance. Each server instance has its own `catalina.out` file. By default, the `catalina.out` file is located in the `logs` directory under the Tomcat root directory. For example, `/opt/netiq/idm/apps/tomcat/logs/catalina.out`.

It is recommended that you do not modify the log files manually. Modifying a file could result in the file no longer recording information from the Tomcat server.

By default, a server instance prints only messages of the Info severity level or higher to `standard.out`. You can modify the severity threshold as a logging configuration so that the server prints more or fewer messages to respective log files. For more information, see [“Understanding Logging Configuration” on page 169](#).

Localhost Log

The Localhost log (`localhost_access_log.<date of log generation>.txt`) contains HTTP transactions between the client and the application server. The default location and rotation policy for this log is the same as `catalina.out` file.

Application Log

Each application component provides its own logging. Tomcat provides no support for application logs. Each component includes its own logging configuration that defines default log levels and appender configurations. These logging configuration files are placed in the `\conf` directory of the Tomcat server.

Additional Log Files

The `catalina.out` log messages and log files communicate events and conditions that affect Tomcat server operations. Logs for all application components are logged in the `catalina.out` file. This file also records the interactions between the Tomcat server and the client.

Some subsystems and components also maintain additional log files that help in auditing their individual interactions. The following list describes some of the additional configuration files:

- ◆ Logging is turned off by default and must be enabled in the `setenv.sh` file in the `/TOMCAT_INSTALLED_HOME/bin/` directory.
- ◆ The HTTP subsystem keeps a log of all HTTP transactions between the client and the application server in the, `localhost_access_log.<date of log generation>.txt` file. The default location and rotation policy for this log is the same as the `catalina.out` file. You can set the attributes that define the behavior of HTTP access logs for your server.
- ◆ Each server has a transaction log that stores information about committed transactions coordinated by the server that may not have been completed. Tomcat uses the transaction log when recovering from a system crash or a network failure. You cannot directly view the transaction log because the file is in a binary format.
- ◆ The auditing service records information from a number of security requests, which are determined internally by the security framework. The service also records the event data associated with these security requests and the outcome of the requests. Each server writes auditing data to its own log file in the server directory.
- ◆ The JDBC subsystem records various events related to JDBC connections, including registering JDBC drivers and SQL exceptions. The events related to JDBC are written to the server log, such as when connections are created or refreshed or when configuration changes are made to the JDBC objects.
- ◆ The Java Message Service (JMS) logging is enabled by default when you create a JMS server with Apache ActiveMQ as a JMS provider. Logs can be found in the ActiveMQ installed path at `data/activemq.log`. The JMS persistent store helps to persist email messages. If JMS is not properly configured, any email message in the memory queue will be lost if the application server is shut down.
- ◆ The hibernate framework writes log messages in different categories and log levels. For example, it logs messages for establishing connections with the database, executed SQL statements, or cache interactions. Hibernate logging is enabled by default at the Info level. The events related to JDBC subsystem are written to the server log. All hibernate related information is logged when the data is persisted in the application.

Understanding the Log Format

Workflows use a specific format for file log entries. To improve log entry readability, the log entries in the `catalina.out` files use standard elements. Doing so facilitates the use of non-interactive, stream-oriented editors such as `sgrep`, `sed`, `awk`, and `grep`. The first part of each message begins with a locale-formatted timestamp followed by a data portion that contains information specific to the log entry. The data portion is the most flexible part of a log entry.

A log entry contains the following fields:

```
time-date-stamp [Severity] [Subsystem] [Message Text]
```

The following entry is an example entry that is logged when a user requests a role:

```
[INFO] 2021/07/26 21:15:57 com.novell.soa.af.impl.LogEvent:191 [WORKFLOW]
[Workflow_Started] Initiated by 88293b680a5440c0b9856ee4c2ab72a7, Process
ID: {9}, Process Name: Sample_PRD, Activity: {8}, Recipient:
88293b680a5440c0b9856ee4c2ab72a7, Secondary User: {10}
[INFO] 2021/07/26 21:15:57 com.novell.soa.af.impl.LogEvent:191 [WORKFLOW]
[Workflow_Forwarded] Initiated by System, Process ID: {9}, Process Name:
Sample_PRD, Activity: {8}, Recipient: 88293b680a5440c0b9856ee4c2ab72a7
[INFO] 2021/07/26 21:15:57 com.novell.soa.af.impl.LogEvent:191 [WORKFLOW]
[Workflow_Forwarded] Initiated by System, Process ID: {9}, Process Name:
Sample_PRD, Activity: {8}, Recipient: 88293b680a5440c0b9856ee4c2ab72a7
[INFO] 2021/07/26 21:15:57 com.novell.soa.af.impl.LogEvent:191 [WORKFLOW]
[Workflow_Ended] Initiated by System, Process ID: {9}, Process Name:
Sample_PRD, Activity: {8}, Recipient: 88293b680a5440c0b9856ee4c2ab72a7
```

Most log entries do not use the optional line breaks (`[\\n]`). The time-date-stamp, the severity, subsystem, and message text are on the same line to enable stream-oriented editors that use only one line (such as `grep`) can be used to locate related log entries.

If a message is logged within the context of a transaction, the message text contains the correlation ID assigned to the transaction.

The Tomcat server uses the default character encoding of the host computer for the messages it writes.

Message Fields

A Tomcat server message contains a consistent set of fields, as described in the following table. In addition, if your applications use Tomcat logging services to generate messages, those messages will contain these fields.

Table 18-2 Log Entry Fields

Field	Description
Time-date-stamp	Time and date message originated, in a format specific to the locale. The Java Virtual Machine (JVM) that runs a Tomcat server instance refers to the host computer operating system for information about the local time zone and format. The date and time is specified in the W3C profile format of ISO 8061. It has the following fields: year-month-day-T-hour-minutes-seconds-time zone. The "Z" value for the time zone indicates that the time is specified in UTC.
Severity	Indicates the degree of impact of the event reported by the message such as warning, informational, or debug. In the example log entry, the level of severity is Info.
Subsystem	Indicates the Tomcat subsystem or the type of the module that was the source of the message. For example, JMS.

Field	Description
Message text	<p>A description of the event or condition specific to the log entry. The description can be as simple as an informational string, such as the string in the example log entry:</p> <pre>Example:- [INFO] 2021/07/26 21:15:57 com.novell.soa.af.impl.activity.LogActivity:141 [WORKFLOW] [User_Message] Initiated by 88293b680a5440c0b9856ee4c2ab72a7, Process ID: Sample_PRD, Process Name: Sample_PRD, Activity: Log_0eayajf, Recipient: 88293b680a5440c0b9856ee4c2ab72a7, Author: Sample_PRD, Message: Dont Crash My IgSetup</pre> <p>If a message is logged within the context of a transaction, the message text contains an identifier assigned to the workflow transaction. Workflow transactions are actions such as authenticating a user, processing a request for a role, and request for access to a resource.</p> <p>If a user requests access to multiple resources, the Tomcat server creates multiple request objects and gives each request a separate correlation ID. Tomcat processes each request separately and the status of each can be seen in the user request history.</p> <p>The example log entry contains the following correlation ID:</p> <pre>UserApp#UserStartWorkflow#082080ec-5b10-498f-b87d-28825ab63278</pre>

Message Severity

The severity attribute of a log message indicates the potential impact of the event or condition that the message reports. The following table lists the severity levels of log messages, starting from the lowest to the highest level of impact.

Level	Description
Fatal	The least detail. Writes fatal errors to the log.
Error	Writes errors that can cause system processing not to proceed.
Warn	Logs potential failures, but the impact on execution is minimal. Warnings indicate that you should be aware that this event is happening and you might want to make a configuration change to avoid it.
Info	A low-level informational message used for reporting normal operations
Debug	Writes debugging information.
Trace	Used for most detailed messages. You can configure this level to report the request path of a method.

You can set log severity levels on loggers and appenders. When set on a logger, none of the appenders receives any events that are rejected by that logger. For example, if you set the log level to Info on a logger, none of the appenders will receive Warn level events. When you set a log level on the appender, the restriction applies only to that appender and not to other appenders. For example, if you turn off error for the file appender, no Error messages are written to the log file. However, Error messages are written to the `standard.out` file.

```
<logger name="com.sssw" level="INFO" additivity="true">
    <appender-ref ref="WFCEF"/>
</logger>
<logger name="com.netiq" level="DEBUG" additivity="true">
    <appender-ref ref="WFCEF"/>
</logger>
```

You can set log levels for loggers using the Logging page or the logging configuration file. You can also configure loggers through APIs. You can only enable or disable an appender.

The workflow modules generate many messages of lower severity and fewer messages of higher severity. For example, under normal circumstances, they generate many Info or Trace messages. Applications that use Tomcat logging services can use the severity level of Debug.

19 Configuring Logging

Logging allows you to debug the configurations associated with the various features in Workflow Administration Console. The logging service allows you to write, view, filter, and listen to log messages.

By default, the application saves the logging configuration in the `workflow_logging.xml` file is located in the following directories:

Linux: `/opt/netiq/idm/apps/tomcat/conf/`

Windows: `C:\netiq\idm\apps\tomcat\conf`

Configuring Logging

You can configure logging to troubleshoot errors, or to receive notification for specific events. You can also configure logging to perform the following activities:

- ◆ Allow recording of `Info` level messages from the HTTP subsystem in the log file.
- ◆ Track log information for individual servers in a cluster.
- ◆ Configure an appender to publish messages only whose severity level is warning or higher.
- ◆ Stop recording of `Debug` and `Info` messages in the log file.

You may need to configure the `logging.properties` file in some cases.

The following sections describe the basic tasks involved in logging configuration:

- ◆ [“Understanding Logging Configuration” on page 169](#)
- ◆ [“Understanding the Log Level Settings” on page 170](#)
- ◆ [“Specifying the Severity Level for Commons Logging API Loggers” on page 170](#)
- ◆ [“Editing the Logging Configuration File” on page 171](#)
- ◆ [“Managing Log File Size” on page 171](#)

Understanding Logging Configuration

When you enable logging, the Workflow Administration Console sends a logging request to the subscribed appenders. Tomcat provides appenders for sending log messages to the `standard.out` file and the server log file (`catalina.out`). You can control logging for each type of handler by filtering log messages based on severity level and other criteria. For example, the `Stdout` handler has a notice threshold severity level by default. Therefore, `Info` and `Debug` level messages are not sent to the `standard.out` file.

By default, event messages are logged to the system console and to the Tomcat server log file at the `Info` logging level and above. Events are logged to all activated loggers.

The default behavior of the Tomcat server is to limit the console appender to display log messages with a verbosity of “Info” or less. To see log messages for more verbose levels (for example, Debug), examine the server log file. Low threshold settings, such as debug are extremely verbose and will increase the startup time for Tomcat.

Understanding the Log Level Settings

Console logging involves synchronized writes, so, logging can use a lot of processor resources and impede concurrency. To solve these issues, you can change the priority value default setting to error by accessing **Configuration > Logging**, or by updating the `workflow_logging.xml` file. Locate the root node that looks similar to this:

```
<root>
  <priority value="INFO"/>
</root>
```

Change the priority value to:

```
<root>
  <priority value="ERROR"/>

</root>
```

Assigning a value to the root ensures that, appenders do not have a level assigned that inherits the level of the root.

Specifying the Severity Level for Commons Logging API Loggers

If you are using the commons logging API, the logger names follow the Java package dot notation naming convention. For example, a logger name can be `com.acme.Barlogger`, corresponding to the name of the classes in which it is used. Each dot-separated identifier appears as a node in the logger. In this case, the logger named `com.acme` is a parent of the logger named `com.acme.Barlogger`.

You can configure the severity for a package or for any logger at any level in the tree. For example, if you specify the severity level for package `com.acme=Warn`, then `Fatal` and `Error` messages from the child nodes of this package will be blocked. You can override the severity level of a parent node by setting a value for a child node. For example, if you specify the severity level for `com.acme.Barlogger=Debug`, all log messages from `Barlogger` will be allowed, while `Fatal` and `Error` messages will be filtered for other child nodes under `com.acme`.

You can specify the severity level for a package in Workflow Administration Console by accessing **Configuration > Logging**. The changes will be immediately applied. When you restart the application, the changes will not be preserved. To persist the changes in the database for subsequent sessions, select **Persist the logging changes**.

NOTE: If you change, enable, or disable logging, you do not have to restart Workflow Administration Console to apply the changes.

Editing the Logging Configuration File

The configuration settings for the Workflow Administration Console logging are stored in the `workflow_logging.xml` file, located in the install directory on the Tomcat server. To configure the logging levels and other settings permanently, stop the Tomcat server and change the settings in these files.

NOTE: All loggers specific to the Workflow Administration Console are defined in `workflow_logging.xml`.

To change the log level in the `workflow_logging.xml` file, open the file in a text editor and locate the following entry at the end of the file:

```
<root>
  <priority value="INFO" />
  <appender-ref ref="CONSOLE" />

</root>
```

Assigning a value to root ensures that any log appenders that do not have a level explicitly assigned will inherit the root level (in this case, Info). For example, the file appender does not have a default threshold level assigned. It assumes the root's threshold level.

The log levels used are Debug, Info, Warn, Error, and Fatal. Inappropriate use of these settings can be costly in terms of performance.

A good rule of thumb is to use Info or Debug only when debugging a particular problem.

Any appender included in the root that does have a level threshold set, should have that threshold set to Error, Warn, or Fatal unless you are debugging something.

The performance issues associated with high log levels has less to do with verbosity of messages than with the fact that console and file logging involves synchronous writes.

The default log level of Info in the log configuration file for the Workflow Administration Console is suitable for many environments. However, for a performance intensive environment, you can change the entry as follows:

```
<root>
  <priority value="ERROR"/>

</root>
```

NOTE: Enabling Info and console logging is not needed for a fully tested and debugged production setup.

Managing Log File Size

By default, event messages are logged in the following places:

- ♦ The system console of the application server where you deployed the Workflow Administration Console

- ♦ A log file on that Tomcat server. For example: `/opt/netiq/idm/apps/tomcat/logs/catalina.out`

This is a rolling log file. By default, the server rotates the file every 24 hours. The server does not rotate the local server log file when you start the server.

To immediately rotate the log file, change the appender configuration in the logging configuration file. By default, the rotated files are stored in the same directory as the log file.

Changing the Log Levels for Features

The logs contain information about processing, and interactions that occur while fulfilling users and administrative requests, and during general system processing in the Workflow Administration Console.

In Workflow Administration Console, the packages are grouped based on features, and under each feature includes one or more packages. Each package handles a specific area of a feature and has its own independent log level that obtains event messages from different parts of the application.

The package names are based on Java Development Kit (JDK) conventions. The event messages include these package names, indicating the context of the message output. The logs include tags and values that allow the administrator to identify and correlate the package with the log entries that pertain to a given transaction and user.

By enabling the correct log levels for the features, an administrator can monitor how the application process users and administrative requests.

To change the log level of the features:

- 1 Click **Configuration** > **Logging**.
- 2 Identify the features from the list for which you want to change the log level.
- 3 Select the log level from the drop-down list.

NOTE: By default, the log level is set to **Info** for all the features. For more information on types of log levels, see [“Message Severity” on page 167](#).

NOTE: To retain these changes in the database, you can select the check box for **Persist the logging changes**.

- 4 Click **Apply**.

Adding a Package

You can use this option when you want to add a custom package, or if you want to add a new package that is not a part of a feature.

To add a package:

- 1 Click **Configuration** > **Logging**.
- 2 Expand the **Miscellaneous Logging** section.
- 3 Click the plus sign (+).

- 4 Enter the package name.
- 5 Click **Add**.
- 6 Set the log level for the package by clicking the drop-down list.

NOTE: To retain these changes in the database, you can select the check box for **Persist the logging changes**.

- 7 Click **Apply**.

20 Configuring Logging in a Cluster

This section includes tips for configuring logging in a Tomcat cluster.

- ♦ [“Tomcat Logging” on page 175](#)
- ♦ [“Workflow Logging” on page 176](#)

Tomcat Logging

You can configure Tomcat for logging in a cluster. To enable logging for clusters, you need to edit the `workflow_logging.xml` configuration file, located in the `/conf` directory for the Tomcat server configuration (for example, `tomcat/conf` folder), and uncomment the following section at the end of the file:

```
<!-- Workflow_logging.xml
-->
- <!--
  Uncomment the following to redirect the org.jgroups and
  <appenders>
<!-- CEF appender -->

  <appender class="com.netiq.idm.logging.syslog.CEFSyslogAppender"
name="WFCEF">
<param name="Threshold" value="INFO"/>
<param name="Facility" value="user"/>
<param name="SyslogHost" value="${com.netiq.ism.audit.cef.host:localhost}"
/>
<param name="SyslogPort" value="${com.netiq.ism.audit.cef.port:1468}" />
<param name="SyslogProtocol"
value="${com.netiq.ism.audit.cef.protocol:tcp}" />
<param name="SyslogSslKeystoreFile" value="${com.netiq.idm.audit.cef.tls-
keystore:/opt/netiq/idm/apps/jre/lib/security/cacerts}" />
<param name="SyslogSslKeystorePassword"
value="${com.netiq.idm.audit.cef.tls-keystore-password:KeystorePassword}"
/>
<param name="CacheDir" value="${com.netiq.ism.audit.cef.cache-file-dir:/
opt/netiq/idm/apps}" />
<param name="CacheRolloverSize" value="2"/>
<param name="ApplicationName" value="WORKFLOW"/>
<param name="EventPrefix" value="IDM:" />
</appender>
</appenders>

  <!--
Logger definitions
```

Additivity of true means the loggers defined below will inherit the appenders.

```

-->
<loggers>
<logger name="workflow.log" level="INFO" additivity="true">
<!-- remove this line to turn on CEF Audit
<appender-ref ref="WFCEF"/>
remove this line to turn on CEF Audit -->
</logger>
<logger name="com.novell" level="INFO" additivity="true">
<!-- remove this line to turn on CEF Audit
<appender-ref ref="WFCEF"/>
remove this line to turn on CEF Audit -->
</logger>
<logger name="com.netiq" level="INFO" additivity="true">
<!-- remove this line to turn on CEF Audit
<appender-ref ref="WFCEF"/>
remove this line to turn on CEF Audit -->
</logger>
<logger name="com.sssw" level="INFO" additivity="true">
<!-- remove this line to turn on CEF Audit
<appender-ref ref="WFCEF"/>
remove this line to turn on CEF Audit -->
</logger>
<logger name="com.microfocus" level="INFO" additivity="true">
<!-- remove this line to turn on CEF Audit
<appender-ref ref="WFCEF"/>
remove this line to turn on CEF Audit -->
</logger>
</loggers>
-->

```

You can find the `cluster.log` file in the `log` directory for the Tomcat server configuration (for example, `tomcat/log`).

Workflow Logging

The logging configuration is not propagated to all servers in cluster. For example, if you use the Logging page on a server, in a cluster to set the logging level for **Workflow Process** to Trace, this setting is not propagated to the other servers in the cluster. You must individually configure the level of logging messages for each server in the cluster.

For more information, see [Chapter 19, “Configuring Logging,” on page 169](#).

XI

Understanding Audit Configuration

This section provides an overview of audit configuration in the Workflow Administration Console.

IMPORTANT: In a SaaS environment, only the SaaS operations administrator can configure the settings on this page.

- ◆ [Chapter 21, “Configure Audit Events Overview,” on page 179](#)
- ◆ [Chapter 22, “Configuring Audit Events,” on page 181](#)

21 Configure Audit Events Overview

In the Workflow Administration Console the audit events are saved either in the log files, syslog server, Tomcat server, or in the configured database such as, Postgres, MSSQL, Oracle, or Vertica. After you enable auditing, the Workflow Administration Console sends the configuration to the workflow server, and then to the workflow runtime database where all the audit configurations are stored. The Workflow Administration Console retrieves data from the workflow runtime database and populates it in the console when required.

22 Configuring Audit Events

Audit event logs allow you to provide evidence that you are complying with regulations. The Workflow Administration Console logs the events in Common Event Format (CEF) that enables you to collect and aggregate the data for further analysis. Depending on your audit configuration, the Workflow Administration Console sends audit event information to one of these locations:

Tomcat

Saves the audit events in the `catalina.out` file.

Syslog

Saves the audit events in the syslog server. If the syslog server is not reachable the audit events are saved in the cache file that is configured.

File

Saves the audit events in the file that is configured in the specified directory.

Enabling and Disabling the Audit Configuration

You can enable one or all the audit configurations as per your requirements. If you enable all the audit configuration options, the Workflow Administration Console saves the audit events in all the locations. To view the audit events, see [workflow audit events \(https://www.microfocus.com/documentation/identity-governance-and-administration/igaas/tech-refs/WorkflowAuditEventsTable.pdf\)](https://www.microfocus.com/documentation/identity-governance-and-administration/igaas/tech-refs/WorkflowAuditEventsTable.pdf).

To enable or disable the audit configuration:

- 1 Log in to the Workflow Administration Console, then select **Configuration > Audit Configuration**.
- 2 Select the location where you want to save the audit events.

After you select, the Workflow Administration Console automatically saves your selection. The table below lists the properties which you can modify for audit configuration.

Properties	Description
Truncate-to-cef	Truncates the audit messages when they cross the specified word limit.
Host	Specifies the IP of the auditing server.
Protocol	Specifies the protocol the Workflow Administration Console uses to establish communication with the auditing server. You can use either TCP or UDP.
Keystore password	Specifies the password for the keystore type.

Properties	Description
Keystore type	Specifies the keystore type.
Check TLS certificate expiration	Checks if the TLS (Transport Layer Security) certificate has expired or not. If the certificate has expired, then the Workflow Administration Console saves the audit events in the cache file. If not, it saves the audit events in the keystore file.
Keystore file	Specifies where the Workflow Administration Console saves the certificates.
Port	Specifies the port number of the auditing server.
Cache file	The Workflow Administration Console saves the audit events in a cache file when the syslog server is unreachable. After the syslog server becomes available, the Workflow Administration Console rolls back the events saved in the cache file to the syslog server.
Cache dir	Specifies the directory where the cache file is located.
Filename prefix	Specifies the prefix of the filename.
Directory	Specifies the directory where the file is located.
Filename suffix	Specifies the suffix of the filename.
SSL type	Specifies the authentication type, server or mutual.
JDBC username	Specifies the user name of the database.
Fallback datasource	Specifies the data source that persists the events temporarily when audit database is down.
Fallback tablename	Specifies the table name that stores the audit events temporarily in the fallback datasource when the audit database is down.
Tablename	Specifies the database table where the audit events are stored.
JDBC URL	Specifies the database connection URL where the audit events are stored.
Use SSL	Specifies whether the communication between entities is SSL secured or not.
JDBC password	Specifies the password used to access the database.
Schema	Specifies the identifier for the database. In the Postgres database, the default value is public.
Driver	Specifies the driver that is used to connect to the database.
Truststore password	Specifies the password for the truststore type.

Properties	Description
Truststore file	Specifies the path to the truststore that contains all trusted certificates.
Truststore type	Specifies the truststore type, that is, JKS.
