Sun™ Identity Manager 8.0 Workflows, Forms, and Views

Sun Microsystems, Inc.
4150 Network Circle
Santa Clara, CA 95054
U.S.A.

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Contents

Preface

This *Sun™ Identity Manager Workflows, Forms, and Views* publication provides an overview of the reference and procedural information you will use to customize Sun™ Identity Manager for your environment.

Who Should Use This Book

Sun Identity Manager Workflows, Forms, and Views was designed for deployers and administrators who will create and update workflows, views, rules, system configurations and other configuration files necessary to customize Identity Manager for a customer installation during different phases of product deployment.

Deployers should have a background in programming and should be comfortable with XML, Java, Emacs and/or IDEs such as Eclipse or NetBeans.

How This Book Is Organized

Identity Manager Workflows, Forms, and Views is organized into these chapters:

- Chapter 1, "Identity Manager Workflow" — Describes the Sun™ Identity Manager (Identity Manager) workflow.
- Chapter 2, "Identity Manager Forms" — Describes how to customize the appearance and behavior of selected pages in Identity Manager Administrator and User Interfaces by customizing the *forms* that define these pages.
- Chapter 3, "XPRESS Language" — Introduces the basic features of XPRESS, an XML-based expression and scripting language used throughout Identity Manager.

- Chapter 4, “XML Object Language” — Introduces the basic features of the XML Object language, which is a collection of XML elements that you can use to represent common Java objects such as strings, lists, and maps.
- Chapter 5, “Identity Manager Views” — Introduces Identity Manager views, which are data structures used in Identity Manager.
- Chapter 6, “HTML Display Components” — Describes the Identity Manager HTML display component library. HTML display components are used when customizing forms.
- Appendix A, “Form and Process Mappings” — Lists the forms and workflow processes used in Identity Manager and their corresponding system names.

Conventions Used in This Book

The tables in this section describe the conventions used in this book.

Typographic Conventions

The following table describes the typographic conventions used in this book.

Table 1 Typographic Conventions

Typeface	Meaning	Examples
`AaBbCc123` (Monospace)	API and language elements, HTML tags, Web site URLs, command names, file names, directory path names, onscreen computer output, sample code.	Edit your `.login` file. Use `ls -a` to list all files. `% You have mail.`
`AaBbCc123` (Monospace bold)	What you type, when contrasted with onscreen computer output.	`% su` `Password:`
AaBbCc123 (Italic)	Book titles, new terms, words to be emphasized. A placeholder in a command or path name to be replaced with a real name or value.	Read Chapter 6 in the *User's Guide*. These are called *class* options. Do *not* save the file. The file is located in the *install-dir*`/bin` directory.

Symbols

The following table describes the symbol conventions used in this book.

Table 2 Symbol Conventions

Symbol	Description	Example	Meaning
`[ ]`	Contains optional command options.	`ls [-l]`	The `-l` option is not required.
-	Joins simultaneous multiple keystrokes.	Control-A	Press the Control key while you press the A key.
+	Joins consecutive multiple keystrokes.	Ctrl+A+N	Press the Control key, release it, and then press the subsequent keys.
>	Indicates menu item selection in a graphical user interface.	File > New > Templates	From the File menu, choose New. From the New submenu, choose Templates.

Shell Prompts

The following table describes the shell prompts used in this book.

Table 3 Shell Prompts

Shell	Prompt
C shell on UNIX or Linux	*machine-name*`%`
C shell superuser on UNIX or Linux	*machine-name*`#`
Bourne shell and Korn shell on UNIX or Linux	`$`
Bourne shell and Korn shell superuser on UNIX or Linux	`#`
Windows command line	`C:\`

Related Documentation and Help

Sun Microsystems provides additional documentation and information to help you install, use, and configure Identity Manager:

- *Identity Manager Installation*: Step-by-step instructions and reference information to help you install and configure Identity Manager and associated software.
- *Identity Manager Upgrade*: Step-by-step instructions and reference information to help you upgrade and configure Identity Manager and associated software.
- *Identity Manager Administration*: Procedures, tutorials, and examples that describe how to use Identity Manager to provide secure user access to your enterprise information systems and manage user compliance.
- *Identity Manager Deployment Tools*: Reference and procedural information that describes how to use different Identity Manager deployment tool. This information addresses rules and rules libraries, common tasks and processes, and the SOAP-based web service interface provided by the Identity Manager server.
- *Identity Manager Technical Deployment Overview*: Conceptual overview of the Identity Manager product (including object architectures) with an introduction to basic product components.
- *Identity Manager Resources Reference*: Reference and procedural information that describes how to load and synchronize account information from a resource into Sun™ Identity Manager.
- *Identity Manager Tuning, Troubleshooting, and Error Messages*: Reference and procedural information that provides guidance for tuning Sun™ Identity Manager, provide instructions for tracing and troubleshooting problems, and describe the error messages and exceptions you might encounter as you work with the product.
- *Identity Manager Service Provider Edition Deployment*: Reference and procedural information that describes how to plan and implement Sun Java™ System Identity Manager Service Provider Edition.
- *Identity Manager Help*: Online guidance and information that offer complete procedural, reference, and terminology information about Identity Manager. You can access help by clicking the Help link from the Identity Manager menu bar. Guidance (field-specific information) is available on key fields.

Accessing Sun Resources Online

For product downloads, professional services, patches and support, and additional developer information, go to the following:

- Download Center
  http://wwws.sun.com/software/download/
- Professional Services
  http://www.sun.com/service/sunps/sunone/index.html
- Sun Enterprise Services, Solaris Patches, and Support
  http://sunsolve.sun.com/
- Developer Information
  http://developers.sun.com/prodtech/index.html

Contacting Sun Technical Support

If you have technical questions about this product that are not answered in the product documentation, contact customer support using one of the following mechanisms:

- The online support Web site at http://www.sun.com/service/online/us
- The telephone dispatch number associated with your maintenance contract

Related Third-Party Web Site References

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To share your comments, go to http://docs.sun.com and click Send Comments. In the online form, provide the document title and part number. The part number is a seven-digit or nine-digit number that can be found on the title page of the book or at the top of the document.

For example, the title of this book is Sun Java™ System *Identity Manager Workflows, Forms, and Views*, and the part number is 820-2964-10.

Chapter 1

Workflow

This chapter describes Sun Identity Manager workflow.

Topics in this Chapter

- Understanding Workflow
- Default Workflow Processes

Related Chapters

- XPRESS Language – Lists and describes use expressions written in the XPRESS language to include logic in workflows and forms.

NOTE	To better understand a typical workflow, use the Identity Manager IDE plug-in to view, run, and debug sample workflows. Instructions for installing and configuring the Identity Manager IDE are provided on https://identitymanageride.dev.java.net.

Understanding Workflow

Identity Manager *workflow* defines a sequence of actions and tasks that are performed consistently according to a defined rule set. Using the Identity Manager Integrated Development Environment (IDE) graphical interface, you can customize each workflow launched by Identity Manager.

Before working with workflow, develop an understanding of:

- General workflow concepts
- How workflow is used in Identity Manager

What is Workflow?

In general terms, a *workflow* is a logical, repeatable process during which documents, information, or tasks are passed from one participant to another for action, according to a set of procedural rules. A *participant* is a person, machine, or both.

In Identity Manager, this concept is specifically implemented as the Identity Manager workflow component, which comprises multiple processes (workflows) that control creation, update, enabling, disabling, and deletion of user accounts.

Depending upon where you are in the product interface, workflows are referred as *workflows*, *tasks*, *process*, or *TaskDefinitions*.

When is Workflow Used?

Most Identity Manager tasks you perform are defined as a set of workflow processes. When you create a user in Identity Manager, for example, the corresponding workflow process defines and conducts activities that:

- Check password policies
- Send email to approvers
- Evaluate the results of each approval
- Create user accounts
- Create audit records

Workflows can run automatically without any user interaction or require user interaction in the form of an approval.

Workflows are typically launched as a side effect of checking in a view. Views are checked in when you click **Save** on a page that implements forms and views.

Workflows in the Repository

Within the Identity Manager repository, a workflow exists as a configuration object, typically of Type WFProcess. (The single exception to this object definition is the Create User workflow, which is defined as a ProvisioningTask object.) The taskType is always `Workflow`.

NOTE Identity Manager does not lock the repository object (that is, the User) while a workflow is executing. This is because workflows can run for days, and the repository object cannot remain unlocked for that long. However, Identity Manager prevents you from launching another update workflow on the same user.

Task Definitions and Task Definitions

The launched instance of a `TaskDefinition` is represented as a `TaskInstance` object. You can view both object types from the Debug page. To access either Task Definitions or Task Instances current for your deployment, follow these steps:

1. From the Debug page of the Identity Manager Administrator Interface, select TaskDefinition from the Type menu adjacent to the **List Objects** button
2. Click **List Objects**. Identity Manager displays a list of the available object types that you have access to.
3. Select an object (for example, `TaskDefinition`). Identity Manager displays all instances of that object type that you have permission to see.

Once a workflow task is launched, the workflow engine creates a *TaskInstance* in the repository. A TaskInstance is an object in the repository that holds the runtime state of an executing workflow process. It stores context variables and immediate transition information for the TaskDefinition from which it was spawned.

The TaskInstance references the descriptive TaskDefinition object through the TaskDefinition object's generated ID. If you edit a TaskDefinition, TaskInstances already in execution will continue to use the old TaskDefinition object, but new ones will use the modified TaskDefinition with its newly generated ID.

When Are Task Instances Deleted?

The life of a TaskInstance is determined by the `resultLimit` parameter. If the result limit is zero, the task will be deleted immediately after completion. If it is positive, the value is the number of minutes that the TaskInstance is kept.

To delete a suspended workflow TaskInstance

1. Click the Manage Tasks tab in the Identity Manager Administrator Interface.
2. Select View All Tasks.
3. Select the suspended TaskInstance, then click **Terminate**.

Task Definition Parameters

The following table lists the standard configuration parameters.

Table 1-1 Standard Workflow Configuration Parameters

Parameter	Description
`name`	Specifies the user-supplied name of the workflow as presented in the Identity Manager interface. Names should be unique among objects of this type, but objects of different types can have the same name.
`taskType`	Used for filtering purposes only
`executor`	Identifies the name of the class that implements the task. By default, for workflows this class is com.waveset.workflow.WorkflowExecutor.
`suspendedable`	(Boolean) Indicates that the task can be suspended and resumed. Default is true.
`syncControlAllowed`	(Boolean) Indicates whether the user is permitted to request synchronous or asynchronous execution. Default is true.
`execMode`	Specifies the type of execution we should use by default. Default is sync. If this value is null, or set to ExecMode.DEFAULT, we treat it as ExecMode.ASYNC.
`executionLimit`	Specifies the limit in seconds that the task is allowed to execute. The task can specify a limit on the amount of time it is allowed to execute. If it exceeds this limit, the scheduler is allowed to terminate it. A limit of zero means there is no limit. Default is 0.

Table 1-1 Standard Workflow Configuration Parameters

Parameter	Description
`resultLimit`	Specifies the limit in seconds that a task instance is allowed to live after the task has completed. Default is 0. Once a task has completed or terminated, the TaskInstance containing the task result is typically kept in the repository for a designated period of time, after which it is automatically deleted. 0 – Indicates that the TaskInstance will be deleted immediately after the task is complete. -1 – Indicates that the TaskInstance will never be automatically deleted, though it can be manually deleted by the user. This parameter is typically set to a value that is equivalent to a few days for tasks that generate reports for later analysis. Set to zero for tasks that are run only for side effect and do not generate any meaningful result.
`resultOption`	(String) Specifies the options how the results of prior executions of repetitive tasks are handled. This object defines that data, and how to ask for it. Default is `delete`. `wait` – Prevents the task from being run until the old result is manually deleted or expires. If this is a non-scheduled task, it results in an error at the time it is launched. If this is a scheduled task, the scheduler simply ignores it. `delete` – Automatically deletes old results before executing the task. The old tasks must be in a finished state. `rename` – Renames old results before executing the task. The old task must be in a finished state. `terminate` – Terminates and deletes any currently executing task. This is similar to the DELETE option, but it also automatically terminates the task if it is running.
`ayncExec`	When set to true, specifies that the workflow continues to run after the completion of the action until the next manual action, and displays the next work item to the user immediately. This setting supports wizard-style workflows. When set to false, the workflow continues execution in the background, and the user must go to a different page (typically the approvals page) when he needs to perform the next step in the workflow.
`visibility`	(String) Declares the visibility of this task definition. Default is `run schedule`. Other options include `invisible`, `run task`, and `schedule task`.

Table 1-1 Standard Workflow Configuration Parameters

Parameter	Description
`progressInterval`	Specifies the interval in milliseconds that Identity Manager should check for progress updates. The task can specify an interval at which the task will be updating its progress. Defaults to 5000 milliseconds (five seconds). Specifying a shorter interval will give you more current task status, but increases the load on the server.

Workflow Engine

The workflow engine is a software service that provides the run-time execution for a workflow process. The functions provided by the workflow engine to support a workflow process include:

- Interpreting the process definition
- Creating process instances and managing their execution
- Navigating between activities and creating work items for their processing

Identity Manager captures activity-level variables for activities that contain a manual action. To minimize the storage needed for a workflow task, the workflow engine removes all other variables (before export) for completed activities to minimize the storage needed for a workflow task.

Workflow Process Components Overview

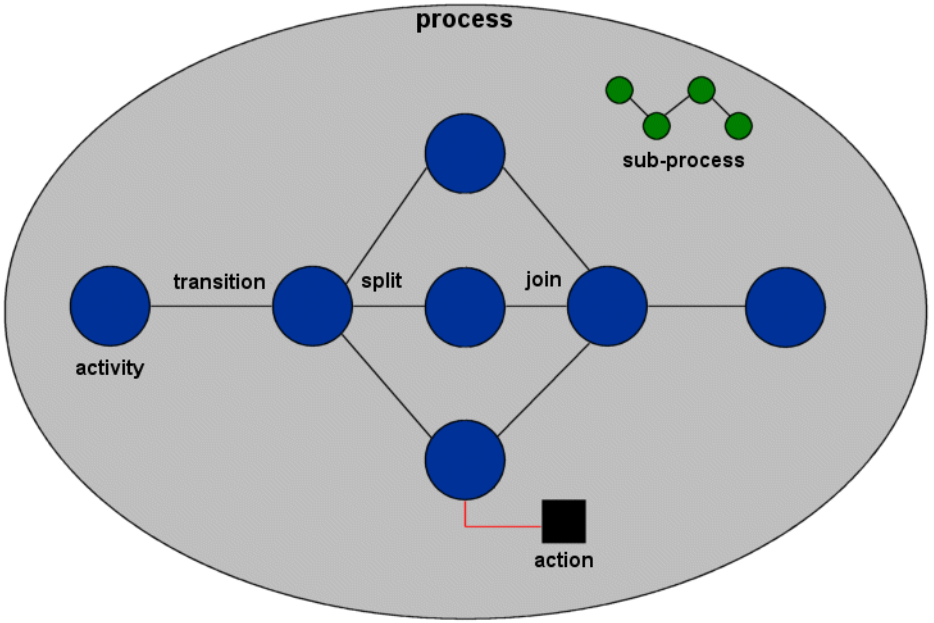
Each workflow process is defined by one or more of the following components. These components are discussed at greater length below.

- **Activity** – Represents a single, logical step in the process.
- **Action** – Defines how an activity is accomplished. An action can be a simple expression evaluation or a call to a complex Java class.
- **Transition** – Defines the movement from one activity to the next.
- **Split** – Defines the movement from a single activity to more than one activity. Splits are further defined as:
  - **OR Split** – Tests each transition path. The first path with a value of TRUE is taken.

- **AND Split** – Takes each transition path.

- **Join –** Defines the movement from multiple activities to a single activity. Join components are further defined as:
  - **OR Join –** Specifies that the first path to complete causes the next activity to begin.
  - **AND Join –** Specifies that the next activity cannot begin until all paths are complete.
- **Subprocess** – Defines a set of activities, actions, and transitions that can be called from other activities in the process.

Figure 1-1 General Workflow Process and Components



Workflow Activity

An activity is a single step in the workflow process. An activity can contain multiple components, including transitions, variables, and actions, but must contain start and end activities.

Neither start nor stop activities have associated actions. A start activity has one or more transitions to the activity that begins the process, but end activities should have no actions associated with them.

Workflow Action

A workflow action describes an operation that is performed within a workflow Activity. Each activity can contain multiple actions. Identity Manager provides the following types of actions.

- Application -- A simple automatic invocation of an application, linked through the WorkflowApplication interface. Application actions can receive arguments and variables, and return variables. Identity Manager provides a comprehensive set of applications for provisioning actions, Repository access, and other utilities.
- Manual -- An action that requires human interaction. Identity Manager forms can specify the names of variables to be requested of the user, and create a WorkItem in the repository for the owner(s) of the action.
- Expression -- An automatic action that is defined using an XPRESS language expression. Script actions are typically XPRESS or JavaScript programs.
- Subprocess -- An action performed by recursively invoking another workflow process. Subprocesses can be defined within the root process only.

Workflow Action Variables

Table 1-2

Workflow Action Variable	Description
`name`	(Optional) inherited from WorkflowComponent. Action names are typically null.
`id`	Identifies each action by a unique numeric ID. This is currently the index into the action array of the activity.
`title`	(Optional) Used to calculate a title for this action in the Workflow summary diagram. By default, the title is name, but this variable can include information such as variable values.
`manual`	Indicates whether the action is manual (flag). This value has priority over all other action type fields.

Table 1-2

Workflow Action Variable	Description
request	Used to calculate the request string for a manual action's work item. This text is displayed in the product interface, should be brief, and should clearly describe what is requested of the user (for example, Approve Role Engineering, Supply account ID, and Answer a question. If no request is supplied, Identity Manager uses the result of the title. If there is no title, Identity Manager generates a string based on the name and/or title of the Activity.
requester	Used to calculate the requester string for a manual action's work item. This text is displayed in the product interface. It should be the name of a user or administrator that is considered to be the originator of the request. When null, Identity Manager assumes that the requester is the subject that launched the workflow case.
description	Used to calculate the description string for a manual action's work item. This text is displayed in the product interface. It is typically larger than the request string.
timeout	For manual actions, defines the maximum number of minutes that Identity Manager waits for this action to be performed. If the timeout is reached, the workflow executor considers the action completed. Variables must be used to determine the control flow after a timeout The workflow engine sets the WF_TIMEOUT variable to true in the scope of this activity if the item was completed due to timeout.
timeout	Specifies an expression that yields a timeout value.
expression	Specifies the root of the expression tree that defines the action. If this value is set, it takes priority over the subprocess, and application fields.
subprocess	Specifies the name of a subprocess to invoke. This can either be an internal or external subprocess.If external, it can be a type-qualified name, for example, TaskDefinition:foo or Configuration:foo.
subprocess	Specifies a rule that generates a subprocess name. The returned object can be a String or an ObjectRef. If a String, it can identify an internal or external process such as subprocess.
application	Specifies the name of an application that is to be called. This can either be the abstract name of a built-in application, or may be a fully qualified class name of a class that implements the WorkflowApplication interface. The names of the built-in applications are defined by WorkflowExecutor.
owner	If the action type is manual, this field must hold the name of the owner for whom the WorkItem will be created. It can be an Administrator name, or use variable reference syntax (for example, $(ADMIN_NAME)).

Table 1-2

Workflow Action Variable	Description
`delegator`	Specifies an expression used to calculate the delegator string for a manual action's work item. This text is displayed in the GUI, it should be the name of a user or administrator that is considered to be the delegator of the request.
`name`	Specifies an expression that will calculate the work item name. Usually the name will be a randomly generated unique identifier, but in some cases it is desirable to pre-compute the name so that it may be used in email notifications, embedded in a URL that will jump directly to the work item.
`trackingId`	Specifies an expression that will calculate the work item name. Typically, the name will be a randomly generated unique identifier, but in some cases you might want to pre-compute the name so that it can be used in email notifications, embedded in a URL that will jump directly to the work item.
`localForm`	Manual actions can define a form object that can be used by the work list application to prompt the user for the variables expected to be returned when the action is complete. There are three ways to specify a form: • set a self-contained form in _localForm • set a reference to a form in _formRef • have an XPRESS rule that generates a name.
`formRef`	Specifies a reference to an object containing a Form to use when editing the work item for a manual action.
`formRule`	Specifies a rule that will generate the name of a form or a Form object itself.
`arguments`	For all action types, a list of arguments can be specified.These are similar to Variables, but they live in a different namespace, sort of like a local Action variable so you don't have to worry about collision with variable names.
`variables`	A list of locally defined action variables used by manual actions. This is needed when iteration is being used.
`returns`	A list of declarations of action return values. This defines a mapping between variables defined within the action result, and variables defined in the activity/process. This needs more thought, but its the only reasonably simple way I could come up with to perform the mapping without having variable chaos, or introducing path expressions to reference variables created in other scopes (e.g. activity.action.variable)
`iteration`	Specifies an object that defines optional iteration settings for the action.

Table 1-2

Workflow Action Variable	Description
`results`	Specifies a list of result declarations for this action.
`hidden`	Indicates that the action is to be hidden from the workflow summary diagram. (Boolean)
`condition`	Specifies an optional conditional expression.If this is set, the value of the expression must be true, in order to execute the action, if false, the action is ignored.
`checkError`	Indicates whether the action will be run. When true, the action will be run only if the value of WF_ACTION_ERROR is null. This is shorthand for a very common <Condition>.
`comments`	(Optional) Contains arbitrary comments.
`syncExec`	Indicates that the WorkItem created for a manual action should have the synchronous execution flag set. As a result, when the owner checks in a change to the work item, the workflow should be advanced synchronously rather than scheduled for background execution. This is true for "wizard" style workflows where a workflow controls a sequence of pages.
`exposedVariables`	For manual actions, lists the variables that are to be included in the work item. The names can be GenericObject path expressions. If this list is null, then all variables are included.
`editableVariables`	Lists variables that can be edited in the work item and assimilated back into the case (manual actions only).If this list is null, then any variable in the `exposedVariables` list is considered editable. If `exposedVariables` is null, then all workflow variables are editable. Use to avoid collisions where many variables must be exposed to multiple approvers, but each approver is allowed to modify only a subset of the variables.
`Views`	Lists variables that contain views. Inclusion of a view on this list causes Identity Manager to refresh the view when the work item is refreshed.
`ignoreTimeout`	Typically, when a work item times out and is deleted while the user is viewing or editing the item, Identity Manager throws an exception and displays an error page. Occasionally, though, Identity Manager uses a work item only to display (not edit) summary information. These work items can have a short time-out to allow the workflow to continue processing. Setting this option to true causes the Work Item View handler to avoid throwing an exception. It does not affect the behavior of the process.

Table 1-2

Workflow Action Variable	Description
`authType`	Specifies an AuthType to be assigned to the WorkItem that is created for a manual action.Use this variable if you want WorkItems to be authorized differently (for example, granting someone the rights to approve Resource requests but not Organization request.).
`itemType`	Specifies a user-defined type name for the WorkItem created for a manual action. Use this variable to assign custom categories of workitems (for example, "approval" or "wizard").
`targetId`	Optional. Contains the Identity Manager ID of the object being acted on by the work item.
`targetName`	Optional. Contains the Identity Manager Name of the object being acted on by the work item.
`targetObjectClass`	Optional. Contains the objectclass name of the object being acted on.

What is an Application Action?

Application actions permit you to invoke more complex Java calls than you can invoke with script actions.

What is a Manual Action?

A *manual action* is part of the workflow process definition that defines a manual interaction. When the Workflow Executor processes a manual action, Identity Manager creates a WorkItem object in the Repository. The work item must be marked complete before the workflow can proceed. You must associate an owner with a Manual Action. An owner can be an expression that determines an owner.

Because most manual actions are used to solicit approvals, the work item table is located under the Approvals tab of the Administrator Interface. Any manual action that belongs to a workflow is represented by a WorkItem object in the Repository.The WorkItem view contains a few attributes that pertain to the WorkItem object itself, as well as values of selected workflow variables copied from the workflow task. These include attributes, such as owners of pending approvals, and the form used to approve the WorkItem.Identity Manager incorporates ManualActions in the standard workflow and allows approvals for organizations, roles, and resources.

You can assign a time-out to a manual action.

Default Workflow Processes

Using the Identity Manager IDE, you can edit the default Identity Manager processes to follow a custom set of steps. The Identity Manager workflow capability includes a library of default workflow processes, which includes:

- **User workflows** — Define the steps for tasks related to Identity Manager users, including creating, deleting, updating, enabling, disabling, and renaming users.
- **Identity Manager object workflows** — Define the steps for all tasks related to Identity Manager objects, including resources, resource groups, organizations, and organizational units. For example, some workflows, such as the Manage Role and Manage Workflows workflows, simply commit view changes to the repository, while providing hooks for approvals and other customizations.
- **Miscellaneous workflows** — Define the steps for various Identity Manager features and objects such as reconciliation, Remedy templates, and other custom tasks.

Example

The following Create User workflow has been modified to call an escalate activity if a timeout value is reached. If the time out is not reached, then the results of the APPROVED variable are evaluated. The results of the evaluation determines whether to transition to the approved or rejected activity.

Code Example 1-1

```
<Activity name='Wait'>
   <ManualAction name='approve' timeout='180'>
   <Owner name='$(APPROVER)'/>
   <Variable name='APPROVAL' value='false'/>
   <Return from='APPROVAL' to='APPROVED'/>
   <FormRef>
     <ObjectRef type='UserForm' id='#ID#UserForm:ApprovalForm'/>
   </FormRef>
   <ReportTitle>
     <concat>
       <s>Awaiting approval from \n</s>
       <ref>APPROVER</ref>
     </concat>
   </ReportTitle>
   </ManualAction>
   <Transition to='Escalate'>
     <eq>
       <ref>WF_ACTION_TIMEOUT</ref>
       <s>true</s>
     </eq>
   </Transition>
   <Transition to='Approved'>
     <eq>
       <ref>APPROVED</ref>
       <s>true</s>
     </eq>
   </Transition>
   <Transition to='Rejected'/>
</Activity>
```

WorkItem Types

Manual actions have the ability to assign a type to the work item that is generated when the manual action is executed by the workflow engine. You can assign the work item type in a customization to filter the set of **v** to be displayed or operated upon.

The following work item types are recognized by the system.

Table 1-3 Work Item Types

Work Item Type	Description
approval	Indicates that the work item represents an approval.
wizard	Indicates that the work item represents an arbitrary interaction with the user.

Table 1-3 Work Item Types

Work Item Type	Description
suspend	Indicates that the work item is temporary. Use this type to force a workflow into background execution.

In addition, you can assign customized work item types. For example, you might set the work item type to `resource` to represent a resource approval and `role` to represent a role approval.

WorkItem Context

Work items are launched using the `<ManualAction>` directive. The form associated with a specified workflow can set the base context to `variables.user`. This eliminates the need to put `user.variables` in the variable name.

The WorkItem is the name space, so typical attribute names of the form:

- `complete (WorkItem attribute)`
- `variables.* (task variables)`
- `variables.<view>.accounts[*].*`
- `variables.<view>.waveset.*`
- `variables.<view>.accountInfo.*`
- `:display.session` (*session* for Owner)

Applies to both custom tasks and administrator approvals.

Authorization Types

Manual actions can also specify the *authorization type* of the WorkItem to be created. The authorization type differs from the item type in that the system automatically filters the work items returned in a query to exclude those for which the current administrator is not authorized. Typically, any administrator with the Approver capability is authorized to view all work items in the organizations they control.

To specify a work item authorization type in the manual action, use the `authType` attribute as follows:

```
<ManualAction authType='RoleApproval'>
```

Assigning WorkItem Types

To specify an item type in the ManualAction definition, set the `itemType` attribute as shown in this example:

```
<ManualAction itemType='approval'>
```

Restricting Administrative View Capabilities for WorkItems

Typically, any administrator with the Approver capability is authorized to view *all* work items in the organizations they control. If you want an administrator to view only a subset of the work items in an organization, follow these steps:

1. Define new authorization types that extend the `WorkItem` type. For example, define the `RoleApproval` type.
2. Define new capabilities that have rights on the new authorization types rather than WorkItem itself. For example, define a Role Approver capability that has rights on the `RoleApproval` type.
3. Assign the Role Approver capability to an administrator rather than the general Approver capability
4. Set appropriate authorization types in each manual action in your workflows.

Work Item Delegation

To enable delegation of work items (manual actions) in your workflow, you will need to pass *delegator* and *delegators* as input arguments and reference them in the `<WorkItemDelegator>` and `<WorkItemDelegators>` elements of the `<ManualAction>`, respectively.

You can obtain the value of *delegator* and *delegators* by invoking the `com.waveset.provision.getDelegateObjects` workflow service method, which takes the following arguments:

- One of the following two attributes:
  - `accountId` – Specifies the name of the user for whom you want to get delegation information

    or

    `accountIdList` – Lists the user names for whom you want to get delegation information.
- `delegateWorkItemType` - Specifies the work item type for which you want to get delegation information (that is, approval, roleApproval or attestation). Valid work item types are defined in the WorkItemTypes configuration object.

- `delegateWorkItemTypeObjectName` - Specifies the name of the object for which delegation information is to be gathered. Note that this argument is valid only if the `delegateWorkItemType` is either organizationApproval, resourceApproval, roleApproval or any extensions of those types.
- `delegateWorkItemTypeObjectType` - Specifies the type of object for which delegation information is to be gathered. Note that this argument is valid only if the `delegateWorkItemType` is either organizationApproval, resourceApproval, roleApproval or any extensions of those types.

The service returns a list of delegate objects in the *delegateObjects* argument.

delegateObject

Each *delegateObject* contains the following attributes:

- `approver` – Specifies the approver of this work item.
- `delegator` – Specifies the initial, or first delegator, for the work item. This user is set as the `<WorkItemDelegator>` for the work item.
- `delegators` – Lists delegator names ordered from first to last (before the final approver). This list of users is set as the `<WorkItemDelegators>` element for a manual action. If no delegation was found, this value is null.

Creating Transitions

Transitions define the rules by which an activity moves to one or more other activities. A *transition* can be conditional, which means that it will be taken only if certain conditions are met. Simple activities can contain only one unconditional transition that is taken as soon as the actions within the activity are complete.

Updating a Process for Identity Manager Use

If you customize a process, validate and save your changes to ensure that the workflow process completes correctly and as you expect. After saving, import the modified workflow for use in Identity Manager. You can also use the Identity Manager IDE debugger. For information on the Identity Manager IDE to edit workflow processes, see Using the Identity Manager IDE.

Editing a Workflow in Production

Do not customize a workflow process in a production environment.

Problems can emerge if you edit workflow activities or actions while instances of the original workflow are running. Specifically, the TaskInstance contains a reference to the workflow TaskDefinition and stores the current activity or action by ID. Changing these IDs may prevent the task from restarting where expected when execution resumes.

If you cannot avoid editing a workflow in a production environment, use the following procedure. It will help prevent the loss of pending work items from task instances that are using the old definition.

1. Rename the current TaskDefinition to include a time stamp. For example, to modify the Create User workflow, rename the TaskDefinition from Create User to Create User 20030701. You can rename a workflow TaskDefinition with the Identity Manager IDE.
2. Save and import the edited workflow.

Following this procedure will help prevent problems with existing Create User tasks that may be in a suspended state within Identity Manager. This allows the TaskDefinition to keep its unique ID, which is referenced inside suspended tasks.

Standard Workflows

Identity Manager ships with standard workflows that are mapped to used processes. See "Default Workflow Activities" for a brief introduction to these default workflows. To display and edit a default workflow

1. Open the Identity Manager IDE. For information on using the Identity Manager IDE, see *Introduction to the Identity Manager IDE* in *Identity Manager Deployment Tools*.
2. Select **File > Open Repository Object > Workflow Processes**. The Identity Manager IDE displays the Workflow Processes list, which contains the standard workflow processes and any custom workflows in your deployment.
3. Double-click on the name of the workflow you want to display or edit.

You can view process mappings by selecting **Configure > Form and Process Mappings** from the Identity Manager Administrator Interface.

Customizing a Process

You can change one or more of the Identity Manager processes to eliminate steps, include new steps, or customize existing steps. Each step in the process is represented by an activity.

The Workflow Toolbox facilitates workflow changes by providing pre-defined activities you can use when editing or creating a workflow.

To open the toolbox, right-click in the diagram view and select the toolbox option.

Default Workflow Activities

By category, these default activities are available.

Table 1-4 Default Workflow Activities

Activity	Description
Add Deferred Task	Adds deferred task scanner information to an object.
Audit Object	Creates audit log records.
Authenticate User Credentials	
Authorize Object	Tests authorization for a subject on an object in the repository.
Checkin Object	Commits changes to an object.
Checkin View	Commits an updated view.
Checkout Object	Locks and retrieves a repository object for editing.
	Adds deferred task scanner information to an object.
Checkout View	Gets an updateable view.
Create Resource Object	Creates a resource object.
Create View	Initializes a new view.
Delete Resource Object	Deletes a resource object.
Deprovision Primitive	Deprovisions resource accounts.

Table 1-4 Default Workflow Activities

Activity	Description
Disable Primitive	Disables resource accounts.
Disable User	Disables an Identity Manager user account, resource accounts, or both.
Email Notification	Sends email notification of an action.
Enable Primitive	Enables resource accounts.
Enable User	Enables an Identity Manager user account, resource accounts, or both.
Get Object	Retrieves a repository object.
Get Property	Retrieves a property.
Get View	Gets a read-only view.
List Resource Objects	
Query Object Names	Searches for objects with matching attributes.
Query Objects	Searches for objects with matching attributes.
Query Reference	
Refresh View	Refreshes a view that was previously checked out.
Remove Deferred Task	Removes deferred task scanner information from an object.
Remove Property	Removes an extended property on an object.
Reprovision Primitive	Reprovisions resource accounts.
Run Resource Actions	
Set Property	Adds an extended property to an object.
Unlock Object	Unlocks an object that was previously checked out.
Unlock View	Unlocks a view that was previously checked out.
Update Resource Object	Modifies an object managed by a resource.

Table 1-5 Default Approval Workflows

Activity	Description
Approval	Performs the fundamental single approver process.
Approval Evaluator	Recursively evaluates an Approval Definition Object to implement a complex approval process. Allows the form and template to be used to be passed in, but those can be overridden if specified in the set.
Lighthouse Approval	Performs the default Identity Manager approval process for assigned organizations, roles, and resources. Uses the Approval Evaluator process.
Multi Approval	Distributes approvals among multiple approvers. Users the Approval process for each approver.
Notification Evaluator	Recursively evaluates an Approval Definition Object to implement a complex notification process. The structure is expected to be the same as that defined for Approval Evaluator. In the standard workflow, approval definitions and notification definitions are maintained in the same structure. This is not required for a customized workflow.
Provisioning Notification	Standard process for notifying administrators after a provisioning operation has completed.

Table 1-6 Default User Workflows

Activity	Description
DeProvision	Performs the standard steps to deprovision an existing Identity Manager user, with granular control over resource account deletion, Identity Manager user deletion, unlinking, and de-assignment. Individual resource operations are re-tried until successful.
Provision	Performs the standard steps to create a new Identity Manager user and provision resource accounts. Individual resource operations are re-tried until successful.
Set Password	Changes the password of the Identity Manager account and resource accounts.
Update User Object	Checks out a WSUser object, applies a set of changes, and checks in the object.

Table 1-6 Default User Workflows

Activity	Description
Update User View	Checks out the user view, applies a set of supplied updates, and checks in the user view.
Update View	Applies a collection of changes to any view.

Table 1-7 Default End User Workflows

Activity	Description
End User Update Groups	Updates the group assignments on resources (that support groups) assigned to one of a manager's reports.
End User Update My Groups	Updates the group assignments on resources (that support groups) assigned to the logged-in account.
End User Update Roles	Updates the role assignments for one of a manager's reports.
End User Update My Roles	Updates the role assignments assigned to the logged-in account.
End User Update Resources	Updates the resource assignments and associated attributes for one of a manager's reports.
End User Update My Resources	Updates the resource assignments and associated attributes for the logged-in account.

Table 1-8 Default Compliance Workflows

Activity	Description
Access Review Remediation	Remediation for a single remediator working with a single UserEntitlement
Attestation	Creates a work item for each Attestor, and marks the User entitlement record as APPROVED when all work items complete with approved status, or REJECTED as soon as the first work item rejects. When one work item rejects, all other work items are canceled.
Launch Access Scan	Either launches or schedules an Access Scan Task, depending upon the setting provided by the Access Review task. It is directly called from the Access Review Workflow/Task.
Launch Entitlement Rescan	Launch a rescan of an Access Scan for a single user
Launch Violation Rescan	Launch a rescan of an Audit Policy Scan for a single user
Multi Remediation	Remediation for a single Compliance Violation and multiple remediators
Remediation	Remediation for a single Remediator working with a single Compliance Violation
Scan Notification	Notifies Attestors at the end of each Access Scan that they have pending Attestation workitems. Sends one notification to each Attestor, regardless of the number of pendng workitems. Also notifies the can owner (if any) that the scan has started and completed. This workflow takes the following input: *scanName* -- name of access scan *scanOwner* -- name of access scan owner *recipients* -- list of Identity Manager user names which should be notified *notificationType* --Valid types include begin, end, attest *userCount* -- number of users to be scanned (only on begin)
Standard Attestation	Creates an Attestation Subprocess for each attestor specified.
Standard Attestation	Creates an Attestation Subprocess for each attestor specified.
Test Auto Attestation	Facilitates testing new Review Determination rules without creating Attestation work items. This workflow does not create any work items, and simply terminates shortly after it starts. It leaves all User Entitlement objects in the same state that they were created in by the access scan. Use the Terminate and Delete options to clean up the results from access scans run with this workflow.
Update Compliance Violation	Mitigates a Compliance Violation

Scan Task Variables

The Audit Policy Scan Task and Access Scan Task task definitions both specify the forms to be used when initiating the task. These forms include fields that allow for most, but not all, of the scan task variables to be controlled.

Table 1-9 Scan Task Variables

Variable Name	Default Value	Purpose
`maxThreads`	5	Identifies the number of concurrent users to work at one time for a single scanner. Increase this value to potentially increase throughput when scanning users with accounts on very slow resources.
`userLock`	5000	Indicates time (in mS) spent trying to obtain lock on user to be scanned. If several concurrent scans are scanning the same user, and the user has resources that are slow, increasing this value can result in fewer lock errors, but a slower overall scan.
`scanDelay`	0	Indicates time (in mS) to delay between issuing new scan threads. Can be set to a positive number to force Scanner to be less CPU-hungry.

Workflow Task

Table 1-10

Activity	Description
Add Result	Adds a named data item to the task result.
Add Result Error	Adds an error message to the task result.
Add Result Message	Adds an informational message to the task result.
Background Task	Forces the workflow into the background if it was launched from the Identity Manager Administrator interface.
Get Resource Result	Retrieves the result object returned by a resource adapter on the last provisioning operation.
Get Resource Result Item	Retrieves one result item from the result object returned by a resource adapter on the last provisioning operation.
Rename Task	Renames the task instance in the repository.

Table 1-10

Activity	Description
Scripted Task Executor	Executes BeanShell or JavaScript based on a provided script. As a task, it can be scheduled to run periodically. For example, you can use it to export data from the repository to a database for reporting and analysis. Benefits include the ability to write a custom task without writing custom Java code. (Custom Java code requires a re-compile on every upgrade and must be deployed to every server because the script is embedded in the task there is no need to recompile or deploy it.)
Set Result	Adds an entry to the task entrance result. This will appear in the workflow summary report.
Set Result Limit	Sets the number of seconds the task instance should be retained in the repository when it finishes. A non-negative value indicates that the task instance will be kept for this many seconds after the task has completed. A negative value indicates that the task instance will never be removed automatically. However, you can remove it manually.

Using the Default Rename Task

To use the default rename task without customization, include the following action in your workflow:

```
<Action process='Rename Task'>
   <Argument name='name' value='New Task Name'/>
</Action>
```

Tracking Workflow Progress

The designated owner of a task can always check on the status of a Workflow task. The owner is usually the person that initiated the task, but ownership can be redefined. Because tasks are objects in the repository, they will also be visible to anyone else with sufficient permissions.

Workflow status is typically represented in the Task List State column by the strings **executing**, **pending**, **creating**, and **suspended**. You can add additional, more informative strings summarizing workflow status to this column display.

Implement this feature by adding one of two possible expressions to the WFProcess file:

Code Example 1-2

```
<WFProcess name='queryRoleTask' maxSteps='0'>
   <Status>
     <s>Customized Status</s>
   </Status>
     <Activity id='0' name='start'>
       <Transition to='GetReferencingRoles'/>
     </Activity>
     <Activity name='GetReferencingRoles'>
       <Action id='0'>
     <expression>
<Status> can be any XPRESS statement that results in a string. For example,
<Status>
   <s>custom string</s>
</Status>
or
<Status>
   <block>
     <s>not appearing</s>
     <s>custom string</s>
   </block>
</Status>
```

The results of this expression, if any, are displayed in the Status column when a result is pending (for example, **pending (custom status)**).

Configuring Workflow Properties

The System Configuration object controls workflow configuration properties. The following table lists the most frequently configured properties.

Table 1-11 Workflow Properties in System Configuration Object

Attribute Name	Data Type	Default Value
workflow.consoleTrace	String	false
workflow.fileTrace	null	
workflow.maxSteps	String	5000
workflow.resultTrace	String	false
workflow.retainHistory	String	false
workflow.traceAllObjects	String	false
workflow.traceLevel	String	1
workflow.validationLevel	String	CRITICAL
serverSetting.default.reconciler		

consoleTrace

Specifies whether trace messages are emitted to the console. When set to true, trace messages are emitted. Default is false.

fileTrace

Specifies whether trace messages are emitted to a named file. To send trace messages to a specific file, enter the file name.

maxSteps

Specifies the maximum number of steps allowed in any workflow process or subprocess. Once this level is exceeded, Identity Manager terminates the workflow. This setting is used as a safeguard for detecting when a workflow is stuck in an infinite loop. The default value set in the workflow itself is 0, which indicates that Identity Manager should pull the actual setting value from the global setting stored in the SystemConfiguration object's `workflow.maxSteps` attribute. The value of this global setting is 5000.

resultTrace

Specifies whether trace messages should be retained in the task's result object. When set to true, trace messages accumulate in the task's result object.

retainHistory

Indicates whether the entire history should be returned after the task has completed. When set to true, Identity Manager returns the entire case history. Although it can useful to examine the history when diagnosing process problems, complete results can be large.

traceAllObjects

Indicates whether generic objects should be included in workflow trace operations.

traceLevel

Specifies the level of detail included in workflow trace. An unspecified or 0 value generates the most detail. The default is 1.

validationLevel

Identifies the level of strictness that is applied when validating workflows prior to running them. Errors of this level or greater will result in the workflow not being run. Valid values are CRITICAL, ERROR, WARNING, or NONE, where NONE turns off validation completely.

The default is CRITICAL.

serverSettings.default.reconciler Attributes

You can use these two reconciler attributes to tune per-account workflows:

- `maxRetries` - Specifies the maximum number of times that Identity Manager retries a failed reconciliation request. The default value is 3. Increasing this number will increase reconciliation time, but will also increase the chances of failed requests that eventually succeed.
- `lockwaitThreshold` - Specifies the minimum number of milliseconds that must past between reconcile request retry attempts. The default is 5000 milliseconds (5 seconds). Increasing this number will increase the time required to retry failed attempts, but increases time available to resolve outstanding issues.

The product of these two values should be at least the time required for the customer's per account workflows to succeed. This interval will allow for lock-contention issues to resolve internally in the reconciler.

Consider the following scenario:

- a per-account workflow requires 30 seconds on average to complete
- the value of `maxRetries` is 3
- the value of `lockwaitThreshold` is 5000

The total time spent retrying will be 15 seconds (3 x 5000 milliseconds).

This configuration is not optimal because the total time spent retrying (15 seconds) is less than 30. The customer in this example scenario should increase the `lockwaitThreshold` and `maxRetries` values so that their product exceeds total per-account workflow time.

Using Workflow Services

Identity Manager contains default workflows to define the process for provisioning and manipulating user accounts. When customizing Identity Manager, you can modify these workflows to reflect the business rules that are unique to your deployment environment. Workflow allows you to implement unique business rules for account provisioning in Identity Manager.

This section provides a high level discussion of the following workflow service-related topics:

- method context
- built-in workflow service variables
- default provisioning methods
- default session methods
- view operations
- usage scenarios

For information on specific workflow methods, see `<`*distribution*`>\REF\javadoc`, where <*distribution*> is your installation directory.

Understanding Method Context

The Lighthouse context represents an authenticated session to access the Identity Manager repository, which is subject to authorization checking to enforce visibility and action restrictions. Creating, modifying, and deleting users and other Identity Manager objects required authenticated access to the repository provisioner. This access is established by a context object, typically a LighthouseContext, or a WorkflowContext. Each of these context objects contains an authenticated session object that gives the caller access to the repository.

A context (or Session) is fairly intuitive when operating in the context of a 'logged in environment -- specifically, in a web browser. But within Identity Manager, a workflow is a separate process (actually a TaskInstance), and independent from any browser session, must still access the Identity Manager repository. This is possible because the executing workflow has an active context that is assigned to the workflow when it starts and can be persisted/restored with the workflow when it suspends/resumes.

When a user interacts with a workflow (typically through a WorkItem or ManualAction), the workflow maintains its own context. It does not assume the context of the user interacting with the WorkItem (although that user must possess a context that gives them appropriate access to the WorkItem). If the user interacting with the WorkItem causes a form to be loaded, Identity Manager process the form with the context of the user, not the context of the workflow. To be more precise, the user interacting with the WorkItem is not interacting with the workflow at all. The user is simply interacting with the WorkItem. After the user modifies the WorkItem, the Scheduler will restart the workflow if appropriate.

Workflow Built-In Variables

The workflow engine uses several built-in variables. Most of these variables do not need to be declared in the workflow. However, you can use built-in variables to find out the state of the workflow execution. In addition, many variables are set as a side effect of workflow services.

NOTE Workflow variables are case-sensitive. For example, WF_ACTION_ERROR is not the same as wf_action_error.

Table 1-12 Workflow Built-In Variables

Name	Description
WF_ACTION_ERROR	A built-in variable that will be set to `true` if the previously executed action returned a result containing an error or a thrown exception.
WF_ACTION_RESULT	A built-in variable that will be set to the WavesetResult object returned by the previous action. Use this variable when you want to capture the action's WavesetResult and process it without adding it to the global TaskInstance result. This variable was originally added to support resource retries, where you do not necessarily want to keep adding the resource error messages to the task result on every retry. It is not used often, but can be useful if you ever want to tweak the action result before adding it to the task result.

Table 1-12 Workflow Built-In Variables

Name	Description
WF_ACTION_SUPPRESSED	This built-in variable will be set to `true` if the action was suppressed due to a `<Condition>` expression evaluating to false.
WF_ACTION_TIMEOUT	A built-in variable that will be set to `true` if the previously executed action timed out.
WF_CASE_OWNER	A built-in variable that contains the name of the administrator who launched the workflow task.
WF_CASE_RESULT	A built-in variable that contains the WavesetResult of the TaskInstance. This can be used in actions implemented in XPRESS or JavaScript to retrieve the result. For actions that are implemented as WorkflowApplication classes, they can obtain the result through the WorkflowContext. Because the entire WorkflowContext is exposed through the *WF_CONTEXT* variable, this is not absolutely necessary, but convenient.
WF_CONTEXT	A built-in variable that contains a WorkflowContext object. You can use this in actions implemented in XPRESS or JavaScript to retrieve the WorkflowContext. For actions that are implemented as WorkflowApplication classes, the context is passed in.

General Session Workflow Services Call Structure

Workflows have an internal hierarchical structure that constrain both flow of control and scope of variables. A workflow (also called a Case or WFCase) contains a list of workflow Activity elements. A workflow activity contains a list of Action elements. A variable declared at the WFCase is visible to all Activity and Action elements. If a variable named `color` is declared at the WFCase level, and then again in an Action, they are effectively two different variables, such that changing the value of the `color` variable in the Action will not affect the value of the `color` variable from the WFCase.

Workflow services are called from workflow actions. WorkflowServices provides a set of operations that are selected through the value of the *op* Argument. Each operation can have a different set of arguments, so the calling 'signature' must match the specified service itself. The general form of a workflow service action is shown in the following code example:

```
<Action class='com.waveset.session.WorkflowServices'>
   <Condition/>
   <Argument name='op' value=workflowServiceOp/>
   <Argument name=argname1>
      <expression>value1expression</expression>
   </Argument>
   <Argument name=argname2>
      <expression>value2expression</expression>
   </Argument>
   <Argument name=argnameN>
      <expression>valueNexpression</expression>
   </Argument>
</Action>
```

Each of the supported workflow services has a variable number of required and optional arguments. The *op* argument to the session workflow services call must specify one of the provided services. This is similar to calling a method by reflection, where the name of the method to be called is similar to the name of the workflow service to be executed.

If an *op* argument is given that is not on the following list, the workflow services return:

```
'Unknown WorkflowServices op'
```

and the workflow context variable *WF_ACTION_ERROR* will be non-null.

If an *op* argument is given that is not on the preceding list, a workflow service returns:

```
'Unknown WorkflowServices op'
```

and the workflow context variable *WF_ACTION_ERROR* will be non-null.

Provision Workflow Services

The `com.waveset.provision.WorkflowServices` class also contains a set of services, although they are used less often than the methods in `com.waveset.session.WorkflowServices`. These are the low-level primitives for performing account management, and they are primarily called by the default workflows. In a custom workflow, you might want to use these services, or you might prefer to use the higher level views with `checkoutView` and `checkinView`, which will in turn launch the stock workflows.

The primary purpose of the provison services is to give workflows access to the Provisoner, which in turn has access to Resources and resource accounts. These are the services that actually perform the read/write operations on the resources themselves.

General Provision Workflow Services Call Structure

Workflows have an internal hierarchical structure that constrain both flow of control and scope of variables. A Workflow (also called a Case or WFCase) contains a list of Workflow Activity. A Workflow Activity contains a list of Actions. A variable declared at the WFCase is visible to all Activity and Action elements. If a variable named 'color' is declared at the WFCase level, and then again in an Action, there are effectively two different variables, such that changing the value of the 'color' variable in the Action will not affect the value of the 'color' variable from the WFCase. Workflow services are called from workflow actions. WorkflowServices provides a set of 'operations' that are selected through the value of the 'op' Argument. Each operation may have a different set of arguments, so the calling 'signature' must match the service itself. The general form of a session workflow service action is shown in the following code example:

```
<Action class='com.waveset.provision.WorkflowServices'>
   <Condition/>
   <Argument name='op' value=workflowServiceOp/>
   <Argument name=argname1>
      <expression>value1expression</expression>
   </Argument>
   <Argument name=argname2>
      <expression>value2expression</expression>
   </Argument>
         …
   <Argument name=argnameN>
      <expression>valueNexpression</expression>
   </Argument>
</Action>
```

Each of the supported workflow services will have a variable number of required and optional arguments.

Supported Provision Workflow Services

Following is the list of provision workflow services that Identity Manager currently supports. The *op* argument to the workflow services call must be one of these values.

Table 1-13

Provision Workflow Service	Description
`approve`	Records the approval of a user account.
`auditNativeChangeToAccountAttributes`	Reports native changes to one or more auditable attributes of a resource account.
`authenticateUserCredentials`	Authenticates the user against the resource using the password.
`bulkReprovision`	The method executes a set of queries to find all users that match the given conditions. It then iterates over this list and reprovisions the users one at a time.
`changeResourceAccountPassword`	Changes the password for one or more resource accounts.
`checkDeProvision`	Determines if an account needs deprovisioning before deletion.
`cleanupResult`	Removes null ResultErrors from the task result. This method takes the *op* argument, with a valid value *of* `cleanupResult`.
`createResourceObject`	Creates a resource object (for example, a group).
`deleteResourceAccount`	Deletes a resource account.
`deleteResourceObject`	Deletes a resource object (for example, a group).
`deProvision`	Deletes an Identity Manager account and/or resource accounts.
`deleteUser`	Deletes an Identity Manager user.
`disable`	Disables an Identity Manager account and/or resource accounts.
`enable`	Enables an Identity Manager account and/or resource accounts.
`getApprovals`	Determines the lists of approvals for the assigned role, organization, and resources for an existing account.
`getApprovers`	
`lockOrUnlock`	Locks or unlocks a specified user if the Lighthouse Account Policy associated with the user specifies a lock expiration time.
`notify`	Sends a notification, which is almost always an email.
`provision`	Creates a new Identity Manager account and (optionally) resource accounts.

Table 1-13

Provision Workflow Service	Description
questionLock	Locks the user but does not set a lock expiration time or date.
reject	Records the rejection of a resource account.
reProvision	Updates an existing Identity Manager account.
runResourceAction	Executes a resource action on the specified resource adapter for a resource.
updateResourceObject	
unlinkResourceAccountsFromUser	
validate	

If an *op* argument is given that is not on the preceding list, a workflow service returns:

`'Unknown WorkflowServices op'`

and the workflow context variable `WF_ACTION_ERROR` will be non-null.

Understanding the View Operation Methods

Because most workflow processing involves views, the most common view-related methods used in workflows are the `checkoutView` and `checkinView` methods. Checking out a view object will lock the underlying object such that no other user can write to it. This is especially important in workflow processing because a workflow may check out (lock) a user, and then suspend due to a manual action, leaving the user locked until the manual action is serviced (which could be hours or days later). By default, locks on objects expire in 5 minutes, which poses a second concern for workflows. A check in of an object requires that the caller already have the object locked. So a workflow that checks out a view (implicitly locking the object), suspends for 10 minutes, and the checks in the view will fail because the callers lock will have been aborted due to the 10 minute delay.

The following example shows a typical checkout operation:

Code Example 1-3

```
<Action id='-1' application='com.waveset.session.WorkflowServices'>
   <Argument name='op' value='checkoutView'/>
   <Argument name='type' value='User'/>
   <Argument name='id' value='mfairfield'/>
     <Variable name='view'/>
   <Return from='view' to='user'/>
</Action>
```

Using map of options with Checkout and Checkin Calls

It can be challenging to determining which options you can use as optional arguments (which are defined as part of the UserViewConstants class) for these check out and check in calls. The Javadocs list options in this format:

`OP_TARGETS`

`OP_RAW`

`OP_SKIP_ROLE_ATTRS`

Instead of hard-coding these literal strings in your code when checking for options, Identity Manager provides constants that you can use throughout your code to represent a string. While this is a good coding practice, you cannot reference the static fields of UserViewConstants, such as OP_TARGET_RESOURCES, through XPRESS or workflow.

To identify valid strings that you can pass in the correct value, you can write a test rule that reveals the true string. For example, the following rule returns `TargetResources`.

Code Example 1-4

```
<block>
   <set name='wf_srv'>
      <new class='com.waveset.provision.WorkflowServices'/>
   </set>

   <script>
      var wfSvc = env.get( 'wf_srv' );
      var constant = wfSvc.OP_TARGETS;
```

Code Example 1-4

```
      constant;
   </script>
</block>
```

Although handy for finding out a string, this rule is not appropriate for production deployment because it returns the same string for every call made to it. To minimize this problem, Identity Manager constants that are used in view processing are never changed. Once you have coded the constant in your workflow, the view's interpretation of that constant will not change from release to release.

One you have identified valid strings, you can update your checkout view call as follows. The following code checks out a view that propagates only changes to Identity Manager and Active Directory.

Code Example 1-5

```
<Action id='-1' application='com.waveset.session.WorkflowServices'>
   <Argument name='op' value='checkoutView'/>
   <Argument name='type' value='User'/>
   <Argument name='id' value='mfairfield'/>
   <Argument name='options'>
      <map>
       <s>TargetResources</s>
       <list>
          <s>Lighthouse</s>
          <s>AD</s>
       </list>
     </map>
   </Argument>
<Variable name='view'/>
<Return from='view' to='user'/>
</Action>
```

Best Practices

From a performance perspective, best practice suggests limiting the size of the User view whenever possible. A smaller view means less data is pulled from the resource and sent over the network. Because the view is held as a variable in the workflow, any time the workflow task is suspended the view must be written to

the TaskInstance object. If a system is running thousands of workflows concurrently, and each workflow contains large views, the amount of time spent transferring the view to/from the repository (which includes serialization/deserialization) becomes a significant bottleneck.

The best use of a view is to carry only enough data necessary to allow changes to the user to be made and approved intelligently. If the intent of the caller is to change a user's password on a set of resources, all that is necessary to know to drive this process is a list of accounts associated with the user. Specific account data would not typically be necessary for this process.

Sample Scenario One

A customer might decide to implement a custom workflow so that users can request access to a particular resource, that workflow should check out the User view to allow a change to be submitted to it (pending the appropriate approval). In this example, the only information that probably must be available is the Identity Manager User portion of the view so that the `waveset.resources` list and the `accountInfo` object can be updated appropriately. In this situation, use the `TargetResources` option when checking out the User view to check out only the Identity Manager User portion of the User view with an option map similar to the following:

Code Example 1-6

```
<map>
   <s>TargetResources</s>
   <list>
      <s>Lighthouse</s>
   </list>
</map>
```

You can reduce the size of the User view in the WorkItem view. *Work items* are the objects that represent a task assigned to an individual such as an approval, a delegation, or simply an interruption in a workflow to allow a user to input additional information. Custom workflows create approvals and interact with forms through manual actions. In short, a manual action copies all Workflow variables that are in the scope of the current <ManualAction> element. In addition

to the task context, into a variables object within the WorkItem object. In terms of approvals, you rarely need the full User view and context variables. As a result, consider reducing the WorkItem size by specifying the ExposedVariables argument when defining a ManualAction.

The `<Exposed Variables>` element tells the workflow exactly which variables are necessary to capture in the WorkItem for subsequent processing. Remember that if a single Workflow supports multiple approvers, multiple WorkItems will be created (one for each approver). 100KB here, 100KB there and pretty soon we are talking about some real memory if a workflow has 10 approvers.

Sample Scenario Two

The preceding scenario shows a relatively uncomplicated implementation of single manual action. But typical deployments involve more complicated scenarios. For example, a customer might require that when a user is created, an approval goes to a 'bucket', where one of approximately 25 approvers can select the approval. To mimic a bucket, you can create a work item for each approver in the bucket. All an approver must do is accept the action. Once accepted, Identity Manager can discard the remaining 24 work items, and generates the actual approval work item for the approver who accepted the bucket request.

Consider that there are a total of three buckets that act as escalation tiers. When the approval is processed through Bucket 1, Identity Manager escalates a new request into Bucket 2, and the process begins again. This process results in approximately 26 work items per bucket (25 + 1) multiplied by three (for three buckets). One user request would create 78 work items, granted not all at once. But then consider this occurring in a deployment environment containing a user base of 500,000 users with hundreds of these requests flowing in each day. Had the implementer of this scenario not bothered to size the WorkItem views by using the *ExposedVariables* argument, Identity Manager would store a large amount of bit of non-essential data in the work items and being passed over the JDBC connection.

Code Example 1-7

```
<Activity id='0' name='activity1'>
<ManualAction id='-1'>
 <FormRef>
<String>user</String>
</List>
</ViewVariables>
</ManualAction>
<WorkflowEditor x='53' y='111'/>
</Activity>
```

Code Example 1-7

```
 <ObjectRef type='UserForm' name='Access Review Abort Confirmation
Form'/>
</FormRef>
<ExposedVariables>
<List>
<String>user.waveset.accountId</String>
<String>user.waveset.resources</String>
 <String>user.accounts[Lighthouse].idmManager</String>
<String>user.accounts[Lighthouse].fullname</String>
</List>
   </ExposedVariables>
     <ViewVariables>
     <List>
<String>user</String>
</List>
</ViewVariables>
</ManualAction>
<WorkflowEditor x='53' y='111'/>
</Activity>
```

Sample Scenario Three

You must write a custom user provisioning request workflow for users to execute. This type of workflow might be handy when customers want managers to submit provisioning requests for their direct reports but prefer to avoid making every manager in the organization an Identity Manager administrator.

With these requirements in mind, you create a custom workflow that:

- allows managers to create or update direct reports
- incorporates a ManualAction that allows managers to edit the checked-out view or the newly created view
- ensures that by check in, the process will have gone through (using custom manual actions), or will go through (Using out-of-the-box approval processes), the appropriate approval processes.

You will also need to refresh the view. Refreshing the view means that Identity Manager re-examines the assigned resource information and re-fetches that information from the native resources to update the User view with the latest information (if it changed since view check-out).

You can ensure that Identity Manager refreshes the view by specifying a `ViewVariables` element within the manual action that instructs Identity Manager which variables in the WorkItem's `variables` object should be treated as a view and thus refreshed when requested. See the preceding example for an example of specifying the variable *user* as a ViewVariable.

Enabling Workflow Auditing

Workflow auditing is similar to regular auditing, except that workflow auditing stores additional information to enable time computations. Regular auditing reports that an event occurred, but does not indicate *when* the event started and ended. See the *Identity Manager Administration* book for more information about Identity Manager auditing.

Workflow auditing operations store predefined attribute names and their values per audit event. You can use this feature to instrument a workflow by putting `auditWorkflow` events at the beginning and at the end of workflows, processes, and activities.

NOTE When instrumenting a workflow or process, you are not permitted to put anything in an end activity. You must create a pre-end activity that performs the final `auditWorkflow` event, and then unconditionally transitions to the end event.

To enable workflow auditing, you add the `audit` attribute to a workflow or one or more of its Activities. Once the attribute is in place, activate workflow auditing by selecting the **Audit entire workflow** checkbox in the appropriate task template of the Administrator interface. See the chapter titled "Task Templates" in *Identity Manager Administration* for procedural information about turning on auditing in a task template.

In addition, you must provide an appropriate value for the following actions, which are defined in the `auditconfig.xml` file to allow `auditWorkflow` event pairings. (You can define additional actions.)

- `StartWorkflow`
- `EndWorkflow`
- `StartProcess`
- `EndProcess`

- `StartActivity`
- `EndActivity`

The following as an example call showing just the information the caller must provide:

```
<Action application='com.waveset.session.WorkflowServices'>
   <Argument name='op' value='auditWorkflow'/>
   <Argument name='action' value='StartWorkflow'/>
</Action>
```

NOTE Identity Manager actually stores more information than is shown in the preceding example. Continue to the next section for details.

Workflow auditing operations store predefined attribute names and their values per audit event. You can enable auditing within a workflow by adding the `audit` attribute (set to true) to the `WFProcess` element or to one or more `Activity` elements. Setting the attribute at the `WFProcess` level causes the entire workflow to be audited, while adding the attribute to individual Activity elements causes only certain activities to be audited. If the audit attribute is not set, then auditing is disabled. In addition, auditing must be enabled from within task template that calls the workflow.

What Information Is Stored and Where Is It?

By default, workflow auditing collects most of the information stored by a regular audit event, including the following attributes:

- **WORKFLOW**: Name of the workflow being executed
- **PROCESS**: Name of the current process being executed
- **INSTANCEID**: Unique instance ID of the workflow being executed
- **ACTIVITY**: Activity in which the event is being logged
- **MATCH**: Unique identifier within a workflow instance
- **ORGANIZATION**: The name of the user's organization

These attributes are stored in the `logattr` table and are derived from `auditableAttributesList`.

Identity Manager also checks whether the workflowAuditAttrConds attribute is defined.

You can call certain activities several times within a single instance of a process or a workflow. To match the audit events for a particular activity instance, Identity Manager stores a unique identifier within a workflow instance in the logattr table.

To store additional attributes in the logattr table for a workflow, you must define a workflowAuditAttrConds list (assumed to be a list of GenericObjects). If you define an attrName attribute within the workflowAuditAttrConds list, Identity Manager pulls attrName out of the object within the code — first using attrName as the key, and then storing the attrName value. All keys and values are stored as uppercase values.

Adding Applications

You can register your own Java methods so that they can be accessed from the Identity Manager IDE. To do this:

1. Edit the idm/config/workflowregistry.xml file.
2. Add the application definition, in a form similar to this example:

```
<WorkflowApplication name='Increment Counter'
  class='com.waveset.util.RandomGen' op='nextInt'>

   <ArgumentDefinition name='start' value='10'>
      <Comments>Get the next counter</Comments>
   </ArgumentDefinition>
</WorkflowApplication>
```

3. Restart the Identity Manager IDE.

The new application is added to the application menu.

Chapter 2

Identity Manager Forms

This chapter describes how you can customize the appearance and behavior of selected pages in Sun™ Identity Manager Administrator and User Interfaces by customizing the *forms* that define these pages.

You can use the Identity Manager IDE to view and edit Identity Manager forms and other generic objects. Instructions for installing and configuring the Identity Manager IDE are provided on `https://identitymanageride.dev.java.net`.

Topics in this Chapter

This chapter is organized into the following sections:

- Understanding Forms — Introduces basic form concepts and describes how forms are integrated into Identity Manager.
- Customizing Forms — Describes form programming syntax and logical guidelines to use when working with forms and provides examples of different form elements.
- Testing Your Customized Form— Provides techniques to use when verifying your form syntax and tracing field logic in your custom forms.

Related Chapters

- Identity Manager Views — Identity Manager forms interact with an internal Identity Manager data structure called the user view. When customizing a form, you can call view attributes.
- HTML Display Components — You use the HTML component language to create field definitions when editing a form.

- XPRESS Language — You use expressions to include logic in your forms.

Understanding Forms

To customize Identity Manager's Web-based user interface appearance and function, you must modify the form associated with the web page you want to edit.

The term *form* can describe both the web page where users enter information and the object that contains rules about how to display data in the view. Throughout this guide, the term *form* typically refers to the object that contains rules about how to display data in the view.

This section covers the following topics:

- What are Forms?
- Why Edit Forms?
- Identity Manager Pages that Use Forms
- Edited Forms
- How Do Forms Work?

What Are Forms?

A *form* is an object associated with a page that contains rules about how the browser should display user view attributes on that page. Forms can incorporate business logic and are often used to manipulate view data before it is presented to the user.

For example, to create a new user account, you use the Create User page, in which you enter information about the new user. This page is generated using an object (a form) in the Identity Manager repository named Tabbed User Form. This form specifies which fields are visible on the Create User page and which HTML form element (for example, text box, check box, or select box) is used to represent each field. This form also specifies additional logic for disabling fields, populating empty fields with default values, and calculating field values from the values of other fields.

What Forms Control

Forms control the following objects and activities:

- **Layout and display characteristics of the page**

  Forms are composed of fields. Visible field types include simple text boxes, radio buttons, and selection boxes with multiple values. Fields can also have values based on other fields and can be either read-only or be hidden from view.

- **Data that is used on the page**

  Data can be captured dynamically from a resource or be calculated from other fields. With the Identity Manager expression language called XPRESS, field data can be calculated, concatenated, and logically evaluated.

- **Data that is coming into the system**

  Forms can be the interface from web pages as well as from noninteractive systems such as ActiveSync resources. In this role, the form has no visual fields, but still provides rules to set default values and other field values.

  For example, the Full Name field might not be visible to the administrator using the page, but can be set based on the values that the user enters into the First Name, Middle Name, and Last Name fields. Populating fields from other fields reduces the data entry that users and administrators must perform, consequently reducing potential data entry errors. Likewise, by providing option menus in the place of text input fields, an administrator can select a department from a list instead of entering the department name. For information on the specific HTML components that define the default Identity Manager forms, see HTML Display Components.

- **Identity Manager background processing**

  Forms are also used within Identity Manager in the background processing. For example, forms can work in conjunction with resource adapters to process information from an external resource before storing it in the Identity Manager repository.

  When creating forms to manipulate data in the background, you focus primarily on encoding logic because the appearance is irrelevant in forms that are not visible to users. For more information on using hidden (nonvisible) components, see the section titled Using Hidden Components.

Sample Form

The following XML example defines the form fields that are used by users to enter account ID, first name, last name, and full name. It specifies how the user's full name is built out of the information entered into the First Name and Last Name fields.

Code Example 2-1

```
<Field name='waveset.accountId'/>
   <Display class='text'>
     <Property name='title' value='AccountID'/>
   </Display>
</Field>
<Field name='global.firstname'>
   <Display class='Text'>
      <Property name='title' value='First Name'/>
      <Property name='size' value='32'/>
      <Property name='maxLength' value='128'/>
   </Display>
</Field>
<Field name='global.lastname'>
   <Display class='Text'>
      <Property name='title' value='Last Name'/>
      <Property name='noNewRow' value='true'/>
      <Property name='size' value='32'/>
      <Property name='maxLength' value='128'/>
   </Display>
</Field>
<Field name='global.fullname'>
   <Display class='Text'>
      <Property name='title' value='FullName'/>
      <Property name='size' value='32'/>
      <Property name='maxLength' value='32'/>
   </Display>
      <Expansion>
         <concat>
            <ref>global.firstname</ref>
            <s> </s>
            <ref>global.lastname</ref>
         </concat>
      </Expansion>
</Field>
```

Why Edit Forms?

Why customize the default Identity Manager pages, which already provide all the fields that you need to perform actions within the product? Customizing the default forms allows you to better enforce your company's policies and processes:

- **Preserve privacy by limiting the amount of user account information displayed on the screen**. You may not want to present all of the information available for a user account depending on who is viewing the information because of concerns for privacy or to reduce the distraction from nonessential information.
- **Provide context-specific help on individual fields**. This can reduce confusion and calls into your help desk.
- **Reduce the distraction of nonessential information for users performing a specific task**. Typically, the most effective way to present information is to display only the fields you need to accomplish the current task.

Customizing the default fields in Identity Manager forms allows you to extend and customize the application for your environment. Specifically, you can customize the default forms to:

- **Address the specific needs of the users in your organization**. This is particularly important when several different types of administrators must access different portions of the same view data and should not view all data attributes. For example, a human resources administrator may need to access a different subset of user account attributes than a help desk administrator.
- **Control the display and content of the user account attributes**, particularly attributes displayed on the Create User and Edit User pages. These pages contain most of the attributes that need to be controlled.
- **Define default values for user view attributes** and their associated attributes. For example, you could define a default home directory for a user instead of the administrator having to key in the path.
- **Pre-process user view attributes before they are displayed.** For example, department or division codes that are stored as acronyms or by numeric ID in your resource can be represented with more human-readable full names to your user.
- **Post-process user view attributes data entry**. For example, you can automatically create a mail account based on the value of a location field.
- **Control screen real estate by positioning multiple fields on one line**. By customizing the arrangement of fields in an Identity Manager form, you can make it more closely resemble a printed form or pre-existing web form.

- **Define rules** for the way hidden attributes are calculated. For example, a user's email address can be calculated to be the user's first name, a period, their last name, then the mail domain: `joe.user@sun.com`

Example Scenario

Forms are especially useful in environments where people with varying needs and purposes must access the same data.

For example, you can create a form that hiring managers at your company will use to create a new employee account. The default Tabbed User Form displays more information than the hiring managers need. Rather than displaying all 99 fields in a distractingly busy form that might complicate the user's task, you can create a form in which the hiring managers must fill in only 10 attribute fields and the other 89 attributes are set based on rules that you, the administrator, define.

Identity Manager Pages that Use Forms

Identity Manager forms are typically classified into one of two categories:

- **Forms that drive the graphical user interfaces**. These forms, which can be part of either the Identity Manager Administrator or Identity Manager User Interface, include the pages that users use when:
  - Changing passwords
  - Performing self-service
  - Administrative tasks that involve account creation, system configuration, and workflow tasks.

  You can use the default forms that ship with Identity Manager as springboards for creating your own custom forms. While you will probably want to copy and directly edit only a subset of these forms (see the section titled Edited Forms), you can peruse other forms for examples of how to encode particular attributes or behaviors.
- **Forms that perform background-processing on information being imported into Identity Manager** from an external resource. For example, as part of the process of reading information from a PeopleSoft database into Identity Manager, a form checks employee status on incoming records. If the employee status is not active (A), the form defines a field that disables the Identity Manager account for that user.

The following table shows some of the Identity Manager pages that use forms of the first type. Use this table to identify the form that controls the display characteristics of the page you want to edit.

Table 2-1 Pages and Associated JSPs and Forms

Page You Want to Edit	Associated JSP	Associated Form
Create/Edit User	`account/modify.jsp`	Tabbed User Form
Change User Account Attributes	`user/changeAll.jsp`	End User Form
Welcome	`user/anonmmain.jsp`	Anonymous User Menu
Edit Work Item	`approval/itemEdit.jsp`	Approval Form

Edited Forms

Of the default forms that ship with Identity Manager, you will probably edit one of the following five forms:

- End User Menu Form
- Anonymous User Menu Form
- Tabbed User Form
- End User Form
- Approval Form

These edited forms control the creation and modification of users and the display of the main menu that the user sees. They are described in greater detail in the following sections.

NOTE During view and form interactions through the Administrator Interface JSPs for launching requests (before workflow launch), the view is edited directly. Consequently, the form runs in the namespace specified by the form attribute. Typical attribute namespaces include:

- `accounts[*].*`
- `waveset.*`
- `accountInfo.*`
- `:display.session` (*session for admin*)

Does *not* apply to approval pages.

End User Menu Form

End User Menu Form controls the display of the main menu in the Identity Manager User interface. Typically, this form contains links for changing the user's password, editing account attributes, and changing answers to authentication questions.

You can customize End User Menu Form to add links to launch special workflow processes that are accessible to the user (for example, a process to request access to a system).

NOTE You can set the `RequiresChallenge` property in the End User Interface Change Password Form to require users to reenter their current password before changing the password on their account. For an example of how to set this property, see the Basic Change Password Form in `enduser.xml`.

For example, to present the End-User Test Process as a link to click from the end-user pages, add the entries shown in the following code example:

Code Example 2-2 Adding End-User Test Process link to End User Menu Form

```
<Configuration id='#ID#Configuration:EndUserTasks' name='End User Tasks'>
   <Extension>
     <List>
        <List>
        <String>End-User Test Process</String>
        <String>An example end-user workflow</String>
        </List>
     </List>
```

The Identity Manager User Interface displays a list of self-service processes for selection. This is expected to be a list of lists. The first element of the sublist displays the process name, and the second element describes what the process does.

NOTE Identity Manager re-evaluates this form's `<Default>` expressions whenever the page is refreshed. You can disable this forced regeneration of the form by adding the `doNotRegenerateEndUserMenu` property (set to true) on the End User Menu form.

Identity Manager re-evaluates this form's `<Default>` expressions whenever the page is refreshed. You can disable this forced regeneration of the form by adding the `doNotRegenerateEndUserMenu` property (set to true) on the End User Menu form as follows:

```
<Properties>

   <Property name='doNotRegenerateEndUserMenu'>

      <Boolean>true</Boolean>

   </Property>

</Properties>
```

Anonymous User Menu Form

Anonymous User Menu Form controls the display of the main menu in the Identity Manager User interface when an unknown user logs in.

Identity Manager uses the anonymous end user pages for users who are not defined in the system through the process of *user self-provisioning*. For example, an Identity Manager administrator can set up pass-through authentication for an Active Directory resource. As a result, any person who has an Active Directory account can log in to the Identity Manager User interface. You can customize those pages so that when a user who does not have a Identity Manager account logs in, an Identity Manager user object is created and the Active Directory resource is added. Subsequently, through a series of questions, the system can set up the user's role, organization, and other resources.

You can customize Anonymous User Menu Form to launch workflow processes to request services before an Identity Manager user exists.

Tabbed User Form

Tabbed User Form is the default form used for user creation and modification in the Identity Manager Administrator Interface. You can customize a copy of this form by extending it with a form of your design.

TIP	Do not directly edit the Tabbed User Form. Instead, Sun recommends that you make a copy of this form, give it a unique name, and edit the renamed copy. This will prevent your customized copy from being overwritten during service pack updates and upgrades.

Customize your copy of Tabbed User Form to:

- **Restrict the number of attributes that are displayed on the Edit User page**. By default, this page displays every attribute that is defined on the schema map for a resource, which can result in an overwhelming list of attributes for a hiring manager to fill out.
- **Set the default field types to more helpful select boxes, checkboxes, and multi value fields**. By default, every attribute defined on a resource assigned to a user will appear on the Create User and Edit User pages as a text box (or as a checkbox for Boolean values).
- **Include additional forms to allow common forms to be used on multiple pages**.

Tabbed User Form contains these fields:

- `accountId`
- `firstname`

- lastname
- role
- organization
- password
- confirm password
- email
- resource list
- application list
- MissingFields

NOTE Do not use the MissingFields element in a production environment. It is provided for educational purposes only.

When creating or customizing a User form from the Tabbed User form, you must replace the MissingFields element with explicit references to each individual attribute that can be pushed to the assigned resource. You must provide this replacement to avoid common pitfalls that can result from using the global namespace too heavily. (For example, your workflows will not populate resources unless they use global syntax.)

(The MissingFields field is not actually a field. It is an element that indicates to the form generator that it should automatically generate text fields in the global namespace for all attributes that can be pushed to the assigned resources that are not explicitly declared in the Tabbed User Form.)

By default, every attribute defined on a resource that is assigned to a user appears on the Create User and Edit User pages as a text box (or checkbox for Boolean values).

End User Form

End User Form controls the page that the system displays when a user selects **`Change Other Attributes`** from the `/user/main.jsp` on the Identity Manager User interface. From this page, a user can change his password, authentication questions, and email address.

You can customize End User Form to grant users control over other fields, such as those that handle phone numbers, addresses, and physical office locations.

Approval Form

Approval Form controls the information that is presented to a resource, role, or organization owner when he is designated an approver of user requests. By default, this page displays a set of read-only fields that contain the name of the administrator that started the process. It also displays information about the user, including the account ID, role, organization, and email address.

This form ensures that the resource owner gets a last chance to change a user value before the user is created. By default, approving a user displays all the user attributes in read-only fields.

You can customize Approval Form to:

- Add and remove information about a user.
- Assign the approver the ability to edit this information so that he can modify the information entered on the initial user form.
- Create your own approval forms for different purposes. For example, you can create different approval forms for use when an administrator or resource owner initiates account creation or deletes a user.

How Do Forms Work?

Various factors affect how the browser displays a form. However, form behavior within the browser is primarily determined by:

- **View associated with the form**. All forms are used with views. The most common view used with forms is the user view. The view defines the data that is available when the form is evaluated.
- **Undefined attributes**. The Tabbed User Form provides a mechanism for automatically generating text fields to edit resource account attributes for which fields are not explicitly defined. You can disable this feature in the form.
- **How forms interact with other Identity Manager components**. This includes the process by which Identity Manager evaluates the form, or *form evaluation*. All form-driven pages are processed similarly. For an overview of how Identity Manager evaluates a form, see Form Evaluation in this chapter.
- **Display components used in the form**. Form fields can be associated with a display component that determines how the field is displayed in the browser.

User View and Forms

The *user view* is a data structure that contains all available information about an Identity Manager user. It includes:

- Attributes stored in the Identity Manager repository
- Attributes fetched from resource accounts
- Information derived from other sources such as resources, roles, and organizations

Views contain many attributes, and a *view attribute* is a named value within the view (for example, `waveset.accountId` is the attribute in the user view whose value is the Identity Manager account name).

Most form field names are associated with a view attribute. You associate a field with a view attribute by specifying the name of the view attribute as the name of the form field. For more information, see Defining Field Names.

For more information about the user view, including a reference for all attributes in the user view, see Identity Manager Views

Undefined Attributes

When a resource or role is assigned to a user through the administrative interface, a refresh occurs. The new resource account attributes are then defined in the User view. `<FormRef name = 'Missing Fields'/>` in the Tabbed User Form indicates to the form generator that text fields should be generated for any resource account attributes that do not have a corresponding field explicitly defined in the form. To disable this feature in the Tabbed User Form, delete `<FormRef name = 'Missing Fields'/>`.

Form Evaluation

How the system processes a form helps determine the behavior of the form in the browser. All form-driven pages are processed similarly, as described below:

1. A **page is requested** from the Identity Manager User or Administrator Interface.
2. The **interface requests a view from the server**. A *view* is a collection of named values that can be edited. Each view is associated with a form that defines how the values in the view are displayed to the user.
3. The **server assembles a view** by reading data from one or more objects in the repository. In the case of the user view, account attributes are also retrieved from resources through the resource adapter.

4. **Derivation expressions are evaluated**. These expressions are used to convert cryptic, encoded values from the resource into values that are more meaningful to the user. Derivations are evaluated when the form is first loaded or data is fetched from one or more resources.
5. **Default expressions are evaluated**. These fields are set to the default value if the field is null.
6. **HTML code is generated**. The system processes view data and the form to produce an HTML page. During this processing, the `allowedValues` properties within expressions are evaluated to build `Select` or `MultiSelect` HTML components.
7. The page is presented in the browser, and the user can edit the displayed values. During editing, the user typically modifies fields, which can result in a refresh or recalculation of the page. This causes **the page to be regenerated**, but the system does not yet store the edited data in the repository.
8. **Modified values are assimilated back into the view**. When a refresh event occurs, the interface receives values for all the form fields that were edited in the browser.
9. **Expansion expressions are evaluated**. This can result in additional values being placed into the view. Expansion rules are run whenever the page is recalculated or the form is saved.
10. **The view is refreshed**. The interface asks the server to refresh the view and provides the current set of edited values. The server may insert more values into the view by reading data from the repository or the resources.
11. **Derivation expressions are evaluated**. Typically, derivation expressions are not evaluated when a view is refreshed. In some complex cases, the system can request derivations after the refresh.
12. The system processes the refreshed view and form and **builds another HTML page, which is returned to the browser**. The user sees the effects of the refresh and continues editing. The user can cause the view to be refreshed any number of times (repeating steps 7 through 12 each time) until the user either saves or cancels the changes.
13. A. If the edit is canceled, all the data accumulated in the view is discarded, and the server is informed. As a result, the server can release any repository locks, and control passes to a different page.
14. B. If the edit is saved, the interface receives the values that have been modified and assimilates them into the view (see step 8).

15. **Validation expressions** are evaluated. If field values do not meet required specifications, then an error is presented and the field values can be corrected. Once the changes have been made, the process returns to step 13.
16. **Expansion expressions** are evaluated one last time (see step 9).
17. If the server saves the view, this typically results in the **modification of one or more objects in the repository.** With user views, resource accounts may also be updated.

Several of the preceding steps require iteration over all the fields in the form. These include the evaluation of `Derivation` expressions, the evaluation of `Default` and `Validation` expressions, the generation of HTML, and the evaluation of `Expansion` expressions. During all field iterations, `Disable` expressions are evaluated to determine if this field should be processed. If a `Disable` expression evaluates to true, the field (and any nested fields it contains) is ignored. See *Defining Field Names* in this chapter for more information on these special types of expressions.

Empty Forms

An *empty form* is a form that contains no fields that you can deploy to prevent changes from being applied to the User view during form processing.

Code Example 2-3 Empty Form Object

```
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE Configuration PUBLIC 'waveset.dtd' 'waveset.dtd'>
<Configuration wstype='UserForm'name='Empty Form'>
 <Extension>
    <Form name='Empty Form'>
    </Form>
</Extension>
   <MemberObjectGroups>
      <ObjectRef type='ObjectGroup' name='Top'/>
   </MemberObjectGroups>
</Configuration>
```

NOTE You can implement an empty form as an alternative to `MissingFields`. `MissingFields` attempts to perform its function across the Accounts list in the User view. In contrast, an empty form effectively prevents any changes being applied to the User view during form processing.

When to Use an Empty Form

Use an empty form when

- Checking out a view with minimal side effects.
- Synchronizing data from Active Sync resources and during Load from File. Deployers typically create a customized input form for data synchronization. Identity Manager performs all attribute translations in that input form, and no further form processing is needed. However, because the operation requires an administrative context, and all administrators must use a form, you should assign the administrator's form to an empty form to prevent further, unnecessary form processing being done on the target view.
- Implementing a custom workflow that performs a particular action against a User view but which must avoid any other unforeseen side effects. In those custom workflows, it is common to specify an empty form during the checkout view process.

Using Empty Form during Active Sync Processing

The use of an empty form is an integral part of successful Active Sync processing.

When Identity Manager processes records from the Active Sync resource, it uses either the default form configured for the system (Tabbed User form) or the form, if any, that has been defined for the administrator account.

Because the default Tabbed User Form can have undesired effects on data from the Active Sync resource, best practice suggests creating an empty form and assigning it directly to the proxy administrator rather than using the default form.

NOTE You should directly associate the empty form to the proxy administrator and not through an Admin Role. Setting the empty form at the Admin Role level causes the Tabbed User Form to be invoked during Active Sync processing.

Active Sync Forms

Active Sync-enabled adapters typically use two types of forms during processing: a *resource form* and a *user form*.

Form processing occurs in three steps:

1. Active Sync fields are filled in with attribute and resource information. Use the `activeSync` namespace to retrieve and set attributes on the resource.

2. The resource form is expanded and derived. During this expansion, all user view attributes are available.
3. The user form is expanded and derived.

The `$WSHOME/sample/forms` directory provides sample forms that end with `ActiveSyncForm.xml`. They include logic for handling the cases of new and existing users, as well as logic for disabling or deleting the Identity Manager user when a deletion is detected on the resource.

ActiveSync User Forms

Identity Manager uses two forms when processing ActiveSync user events:

- Proxy Admin form. Identity Manager processes this form during both the User view creation and check in.
- ActiveSync form. Identity Manager processes this form after the initial creation of the User view and after processing the Proxy Admin form. Best practice suggests assigning an empty form to the Proxy Admin so the appropriate form logic is applied to ActiveSync events, and potential problems created by default Tabbed User form are avoided.

Resource Form

The *resource form* is the form that the administrator selects from a pull-down menu when the resource is created or edited. A reference to a selected form is stored in the resource object.

Resource forms are used with Active Sync-enabled adapters in the following ways:

- Translate incoming attributes from the schema map.
- Generate fields such as password, role, and organization.
- Provide simple control logic for custom processing, including logic for handling the cases of new and existing users, as well as logic for disabling or deleting the Identity Manager user when a deletion has been detected.
- Copy and optionally transform attributes from `activeSync` to fields that the user form takes as inputs. The required fields for a creation operation are `waveset.accountId` and `waveset.password`. Other field can be set, too, (for example, `accounts[AD].email` or `waveset.resources`).
- Cancel the processing of the user by setting `IAPI.cancel` to true. This is often used to ignore updates to certain users.

The following example shows a simple field that will ignore all users with the last name Doe.

Resource forms include logic for handling the cases of new and existing users, as well as logic for disabling or deleting the Identity Manager user when a deletion has been detected.

User Form

The *user form* is used for editing from the Identity Manager interface. You assign it by assigning a *proxy administrator* to the adapter. If the proxy administrator has a User form associated with him, this form is applied to the User view at processing time.

Proxy Administrator and the User Form

You set a proxy administrator for an adapter through the `ProxyAdministrator` attribute, which you can set to any Identity Manager administrator. All Active Sync-enabled adapter operations are performed as though the Proxy Administrator was performing them. If no proxy administrator is assigned, the default user form is specified.

Alternative Form to Process Attributes

Best practice suggests keeping common changes, such as deriving a full name from the first and last name, in the *User form*. The *resource form* should contain resource-specific changes, such as disabling the user when their HR status changes. However, you can alternatively place it in an included form after the desired attributes are placed in a common path, such as incoming.

ActiveSync Form Processing

An overview of ActiveSync form processing includes the following phases:

- You create the view using the Proxy Admin form. Avoid letting the `MissingFields` FieldRef populate global attributes from the Proxy Admin form by assigning an empty form to the Administrator.
- Before the ActiveSync form is processed, Identity Manager adds the specific ActiveSync view attributes to the view.

- Identity Manager processes the Input form or the Parameterized ActiveSync form. During this form processing step resources, roles, and the organization are usually specified along with associated resource account attributes. The `feedOp` flag is used to disable/enable fields based on the type of event and the `IAPI.cancel` attribute might be set to ignore specific events. You might also decide to use the `viewOptions.process` flag to specify a custom provisioning task to process the ActiveSync events.
- Identity Manager checks in the view and processes the Proxy Admin form.

End-User Forms

The forms discussed in this section are found in the end-user interface.

End-User Delegation Forms

In the end-user interface, you can access the following forms from the Delegations tab:

- End User View WorkItem Delegations Form
- End User Delegate WorkItems Form

End User View WorkItem Delegations Form

This form consists of a single table that shows all current and past delegations. You can filter this table based on delegation status. Valid status values include Current, Upcoming, and Ended. Users can terminate current delegations, create new delegations, and edit existing delegations.

To configure the list of past delegations displayed by this form, you can set the delegation.historyLength attribute in the SystemConfiguration object. For more information, see the Editing Configuration Objects chapter of the *Identity Manager Technical Deployment Overview*. To configure other aspect of this forms's behavior, see the Delegate WorkItems View in the *Views* chapter of this guide.

End User Delegate WorkItems Form

This form is used to create new and edit existing delegations.

End User Anonymous Enrollment Forms

Users use this set of forms when requesting an Identity Manager account if they do not have one.

- End User Anonymous Enrollment Form. This is the main form for this part of the interface, and is referenced as the launch form when executing the End User anonymous enrollment workflow. It references these forms:
- End User Anonymous Enrollment Validation form. This form provides an example of capturing initial information from the user to validate their relationship (employment) before displaying the completion form.
- End User Anonymous Enrollment Completion Form. This form captures the information required to launch the provisioning task that creates the user account.

Customizing Forms

After familiarizing yourself with the default operation of the Identity Manager product, you can identify pages you'd like to customize.

1. Consult the section titled *Edited Forms* for a list of editable pages and their corresponding forms.
2. To edit a form, launch the Identity Manager IDE and select Open Repository Object. Select the form you want to edit from the popup dialog that is displayed.

This section covers the following topics:

Overview of Customization

You can customize a form to make it more user-friendly, change its display characteristics, or include logic for processing field data.

Basic Steps

The basic steps for customizing any form in the Identity Manager system include:

- **Selecting a form to customize**. Describes how to identify which form to customize.
- **Editing and saving the form**. Presents basic information about modifying the default end user and administrator forms shipped with the product.

- **Testing your changes**. Suggests guidelines for testing your changes before loading them into your production environment and turning on error logging.

Typical Tasks

When you edit a form, you typically perform the following tasks:

- **Add and remove fields in the form.** Typical tasks include removing some default fields or adding additional fields that have been customized for your environment.
- **Define how a field is displayed within a form**. This requires using a library of HTML components shipped with Identity Manager. For information on editing a field's display characteristics, see the section titled Field Display Properties.
- **Set the logical expressions that define the field's value**. To do this, you must create logical expressions using the XPRESS language. For information on working with XPRESS, see *XPRESS Language*.

Table 2-2 Form Elements

Property	Description
Title	Specifies the text that displays adjacent to the form field.
Class	Identifies the HTML display class to which the element belongs.
Required	Identifies whether the element is required to process the form. This field must have a non-null value upon submission. When set, results in a red asterisk appearing to the right of the field. Message text at the bottom of the form indicates that red asterisk denotes fields that must have a value for submission to proceed.
Action	When set, a change causes the page to refresh any `Select` or `MultiSelect` controls. In the Identity Manager Administrator Interface, this causes the underlying view to be refreshed. Role selection exemplifies this behavior. When a new role is selected in the Tabbed User Form, the view is refreshed to reflect the resources that are assigned through that role during that edit session. After the view has been refreshed, resource account attributes on those newly assigned resources can be explicitly set.
No New Row	Used strictly for form layout. When true, forces the field to appear to the right of the proceeding field. For example, Name fields are examples where this is useful, where it is desirable to allow the user to enter the last name, first name, and middle initial from right to left, rather than down the page.

Table 2-2 Form Elements

Property	Description
Hidden	Indicates the field should not be visible to the user. The field is typically used to set attribute values that are calculated form other fields, such as constructing the full name from a concatenation of first and last name.
Title	Controls the character width of the control (text boxes).
Class	Specifies the character width of the control buffer (text boxes). Characters scroll if the user types in a string greater than the value specified by the `size` property.
Required	Identifies the name for this form field, typically a path expression in to the view that is used with this form.

Set the characteristics in the following table from the Main tab view.

Table 2-3 Characteristics Set from Main Tab View

Field	Description
Name	Enter the name for this field. A *field name* is typically a path expression into the view that is being used with this form. All fields that display as editing components (such as text boxes, checkboxes, and selects) must have a name that specifies a view path. Fields that do not display as editing components (such as `SectionHead` and `Javascript`) do not require names. However, you can give non-editing fields names if they need to be referenced by another form through a Field reference.
Title	Enter a title for the field. This title displays adjacent to the field on the form. Select the data type of this element from the drop-down menu immediately adjacent to this field. To edit the text displayed in this field, click the adjacent **Edit** button.
Sub Title	(Optional) Specify text that Identity Manager can display beneath the form title. Select the data type of this element from the drop-down menu immediately adjacent to this field. To edit the text displayed in this field, click the adjacent **Edit** button.
Help Catalog	Enter the help key that associates guidance help with the field. This value is the name of an entry in an associated help catalog specified by the form. Specifying a help key causes an icon to appear to the left of the field. Moving the mouse over the icon causes the text referenced in the help catalog to display.
Base Context	(Not typically used in standard user forms.) Enter the base context to avoid the need to specify the full path in every field. *Base context* identifies the underlying Map (specifically, `com.waveset.object.Genericobject` and is typically named `user` or `userview`. In the Identity Manager Administrator Interface, the editing context is user, so the base context reference is left blank. In forms launched from manual actions, such as approvals, the workflow context is the context of the form.

Table 2-3 Characteristics Set from Main Tab View

Field	Description
Options	Select one or more display options for the field: **Required** – Identifies whether the element is required to process the form. This field must have a non-null value upon submission. When set, results in a red asterisk appearing to the right of the field. Message text at the bottom of the form indicates that red asterisk denotes fields that must have a value for submission to proceed. **Button** – Causes the field to display in a single, horizontal row at the bottom of the form. Otherwise, it displays on the next line of the form. This is most set with fields that use the display class Button. **Action** – When set, a change causes the page to refresh any `Select` or `MultiSelect` controls. In the Identity Manager Administrator Interface, this causes the underlying view to be refreshed. Role selection exemplifies this behavior. When a new role is selected in the Tabbed User Form, the view is refreshed to reflect the resources that are assigned through that role during that edit session. After the view has been refreshed, resource account attributes on those newly assigned resources can be explicitly set. **Library** – Indicates that a field should only display when it is referenced, rather than when it is declared. This is useful when the order in which fields are evaluated on a form may differ from the order in which they are displayed to the user.
Default	Specify an expression to calculate a default value for the field. The default expression is called before the form is displayed if the current value for this field is null.
Derivation	Specify an expression to calculate the value of a field before it is displayed. It is similar to a Default expression, except that it is evaluated even if the current field value is non-null. The derivation expression is evaluated before the form is first displayed, and then again each time the form is refreshed.
Validation	Specify logic to determine whether a value entered in a form is valid. Validation expressions return null to indicate success, or a string containing a readable error message to indicate failure
Expansion	Specify an expression to calculate the value of the field after the form has been submitted. Expansion expressions are typically used with fields that are also marked hidden. Since hidden fields are not directly editable by the user, the value can be calculated with an Expansion expression. See *Hiding Fields*.
Disable	Specify an expression that, if evaluated to true, disables the field and any of its nested fields. A disabled field does not display on the form. It is used to determine if a user has a specific type of resource. If the user does, the form then displays the appropriate fields for that resource.
Display Class	Identify the HTML component class used to render this form component in the browser. By default, the Display Class selection is EditForm. If the form is a link form (such as the End User menu), then select LinkForm from the Display Class options. See the HTML Display Class table in HTML Display Components
size	Controls the character width of the control (text boxes).
maxLength	Specify the maximum number of characters for this element.

TIP A *field name* is often a path expression into the view that is being used with this form, and is typically associated with a particular attribute on a resource. To browse a list of resources and their attributes, click **Browse resources**. The Browse resource dialog opens, displaying an expandable tree of resource types. Click the name of the resource type to display a list of resource instances and the names of their attributes. To use the name of resource attribute as your new form field name, click the resource attribute name, then click **OK**. This inserts the attribute name into the Name field.

Table 2-4 Options for Display Class

HTML Component	Purpose
Apple	Inserts an applet reference into the page.
BackLink	Displays a link that returns to the previous page.
BorderedPanel	A container that organizes its components into 5 regions: north, south, east, west, and center.
Button	Displays a button.
ButtonRow	A container that arranges its components in a horizontal row with padding in between. Typically used to display a row of Button components
CheckBox	Arranges its components in a horizontal row with padding in between. Typically used to display a row of Button components. (Container)
DatePicker	Displays a calendar icon on the page. The user can click this icon to select a calendar date and populate a page field.
EditForm	The default container for forms. Displays component titles in one column and components in another. Each row has an alternating gray or white background.
FileUpload	Variant of the Text component used for specifying the name of a file to be uploaded.
Hidden	A component used to include data into the HTML page that is not displayed

Table 2-4 Options for Display Class

HTML Component	Purpose
Html	Inserts pre-formatted HTML into the page.
Javascript	Defines JavaScript functions.
Label	Displays read-only text.
Link	Places a link on the page.
LinkForm	Places components in a bulleted vertical list with no titles. Typically used for pages that contain lists of Link components. Alternative to EditForm container. (Container)
MultiSelect	Displays a multiselection box, which displays as a two-part object in which a defined set of values in one box can be moved to a "selected" box.
NameValueTable	Displays a list of name/value pairs in a simple table with a beige background.
Panel	Organizes its components in either a horizontal or vertical line.(Container)
Radio	Displays a horizontal list of one or more radio buttons. A user can select only one radio button at a time. If the component value is null or does not match any of the allowed values, no button is selected.
SectionHead	Displays a section heading. These are recognized by the EditForm container to and are rendered in bold text that spans both the title and component columns.
Select	Displays a single-selection list box.
SimpleTable	Arranges components in a simple grid with a row of column titles.
SubTitle	Identifies the text that displays below the form title.
Text	Displays read-only text.
TextArea	Places a link on the page.
Title	Identifies the text that displays at the top of the form.

Table 2-5 Form Elements

Form Element	Description
Name	Enter the name for this field. A field name is typically a path expression into the view that is being used with this form. All fields that display as editing components (such as text boxes, checkboxes, and selects) must have a name that specifies a view path. Fields that do not display as editing components (such as `SectionHead` and `Javascript`) do not require names. However, you can give non-editing fields names if they need to be referenced by another form through a Field reference.
Title	Enter a title for the field. This title displays adjacent to the field on the form. Select the data type of this element from the drop-down menu immediately adjacent to this field. To edit the text displayed in this field, click the adjacent **Edit** button.
Help Key	Enter the help key that associates guidance help with the field. This value is the name of an entry in an associated help catalog specified by the form. Specifying a help key causes an icon to appear to the left of the field. Moving the mouse over the icon causes the text referenced in the help catalog to display.

Table 2-5 Form Elements

Form Element	Description
Options	Select one or more display options for the field: **Required** – An entry or selection in this field is required to process the form. **Button** – Causes the field to display in a single, horizontal row at the bottom of the form. Otherwise, it displays on the next line of the form. This is most set with fields that use the display class `Button`. **Action** – When set, a change causes the page to refresh any `Select` or `MultiSelect` controls. In the Identity Manager Administrator Interface, this causes the underlying view to be refreshed. Role selection exemplifies this behavior. When a new role is selected in the Tabbed User Form, the view is refreshed to reflect the resources that are assigned through that role during that edit session. After the view has been refreshed, resource account attributes on those newly assigned resources can be explicitly set. **Library** – Indicates that a field should only display when it is referenced, rather than when it is declared. This is useful when the order in which fields are evaluated on a form may differ from the order in which they are displayed to the user.
Default	Specify an expression to calculate a default value for the field. The default expression is called before the form is displayed if the current value for this field is null.
Derivation	Specify an expression to calculate the value of a field before it is displayed. It is similar to a Default expression, except that it is evaluated even if the current field value is non-null. The derivation expression is evaluated before the form is first displayed, and then again each time the form is refreshed.

Table 2-5 Form Elements

Form Element	Description
Validation	Specify logic to determine whether a value entered in a form is valid. Validation expressions return null to indicate success, or a string containing a readable error message to indicate failure. Validation rules are evaluated only when a form is submitted, not after each refresh or recalculate.
Expansion	Specify an expression to calculate the value of the field after the form has been submitted. Expansion expressions are typically used with fields that are also marked hidden. Since hidden fields are not directly editable by the user, the value can be calculated with an Expansion expression.
Disable	Specify an expression that, if evaluated to true, disables the field and any of its nested fields. A disabled field does not display on the form. It is used to determine if a user has a specific type of resource. If the user does, the form then displays the appropriate fields for that resource.
Display Class	Identifies the HTML component class used to render this form component in the browser. By default, the Display Class selection is EditForm. If the form is a link form (such as the End User menu), then select LinkForm from the Display Class options. See the HTML Display Class table in HTML Display Components
value	Specifies the property attribute. Typically is a string.
maxLength	Specifies the maximum number of characters for this element.

Table 2-6 Default Services in Forms Toolbox

Service	Description
Text	Displays a regular text entry box.
Secret Text	Displays text as asterisks (*). Typically used for encrypted data like passwords
Select	Displays a single-selection list box. Values for the list box must be supplied by the `allowedValues` property.
MultiSelect	Displays a multiselection text box, which displays as a two-part object in which a defined set of values in one box can be moved to a selected box. Values in the left box are defined by the `allowedValues` property, values are often obtained dynamically by calling a Java method such as `FormUtil.getResources`. The values displayed in the right side of a multiselection box are populated from the current value of the associated view attribute, which is identified through the field name.
Checkbox	Displays a checkbox. When checked, the box represents a value of `true`. An unselected box represents a false value.
Label	Displays a multi-line text entry box
TextArea	Displays a horizontal list of one or more radio buttons. A user can select only one radio button at a time. If the component value is null or does not match any of the allowed values, no button is selected.
Radio	Places a link on the page.
Link	Displays a button.
Button	Refers to a variable that is defined by the view that is used with this form.
accountId	Displays a multi-line text entry box

Additional Customization-Related Topics

The following topics are covered in this section:

- Form structure
- Form components
- Defining fields
- Guidelines for structuring a form

Form Structure

Forms are stored as XML objects within the Identity Manager repository. Each form is stored as its own object with the following structure.

NOTE You do not need to know the XML structure of a form. Identity Manager IDE simplifies working with form structure. This information is supplied for your reference only.

The following stub form illustrates the general structure of a form.

Code Example 2-4

```
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE Configuration PUBLIC 'waveset.dtd' 'waveset.dtd'>
<!--  id="#ID#UserForm:EndUserMenu" name="End User Menu"-->
<Configuration id='#ID#UserForm:EndUserMenu' name='End User Menu'
reateDate='1012185191296' lastModifier='Configurator'
lastModDate='1013190499093' lastMod='44' counter='0' wstype='UserForm'>
   <Extension>
   <Form name='End User Menu'>
      <Display class='LinkForm'>
         <Property name='title' value='User Self Service'/>
         <Property name='subtitle' value='Select one of the following options'/>
      </Display>
Field content
   </Form>
   </Extension>
<MemberObjectGroups>
   <ObjectRef type='ObjectGroup' id='#ID#Top' name='Top'/>
   </MemberObjectGroups>
</Configuration>
```

NOTE The Identity Manager User Interface implements a second XPRESS form that contains the navigation bar. This means that the rendered page has two <FORM> tags, each with a different name attribute:

```
<form name="endUserNavigation">
```

and

```
<form name="mainform">
```

Form Components

The following table identifies form components in the order in which they appear in the form. Each form component is discussed in greater detail below.

Table 2-7 Form Components

Form Component	Purpose
header	Introduces information about the form object definition. Includes start tags for <Form>, <Extension>, and <Configuration> elements and defines form properties (such as title, subtitle, titleWidth displayed when the form is launched).
form body	Contains field definitions, form functions, form variables. This is the part of the form that you will edit.
footer	Closing tags for <Form>, <Extension>, and <Configuration> elements.

Header

The form header includes:

- Standard introductory information included in XML files: the XML declaration and documentation declaration, including the DTD associated with this XML file. In the preceding example, this introductory information is:

```
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE Configuration PUBLIC 'waveset.dtd' 'waveset.dtd'>
```

  This system appends this information to the file. Do not edit.

- Start tags for the <Extension> and <Configuration> elements, which surrounds the HTML components that describe the form's appearance and behavior. The Configuration element contains attributes that describe the form object properties.

The header contains information about the form, including internal identification such as date of creation, login of whoever last modified the file, and the form type. The page processor typically generates this information.

NOTE The system generates the following information for internal use only. Do not edit these attributes.

Table 2-8 Form Header Components

Element	Definition	Syntax/Example
<Extension>	Required to wrap the <Form> element.	<Element>…</Element>
<Configuration>	Contains information that the system uses internally when processing the form object, including the date of last modification and login of the user who last modified this form. Most of this information is typically associated with any persistent object that is stored in the Identity Manager repository. You typically do not need to edit this information.	Configuration id='#ID#UserForm:EndUserMenu' name='End User Menu' createDate='1012185191296' lastModifier='Configurator' lastModDate='1013190499093' lastMod='44' counter='0' wstype='UserForm'>

Form Body

The *form body* is composed of:

- Form properties, which include title, subtitle, and width. These properties are defined in the table titled Form Properties.
- Field elements, which you use to determine the appearance and function of the fields as they appear to the user in the product interface. Fields can also contain XPRESS logic to calculate information. For more information on using the XPRESS language, refer to *XPRESS Language*.

The following table lists form header properties.

Table 2-9 Form Header Properties

Property	Purpose
`title`	Identifies the text that appears at the top of the form. Typically, this title is in a bold font typically larger than the other font on the screen. The form `title` appears under the Identity Manager page. You cannot edit the display characteristics of title. In the example given in the section titled *Form Components*, the value of `title` is `User Self Service`
`subtitle`	Identifies text that appears under title of the form on the page defined by this form. You cannot edit the display characteristics of title. In the preceding example, the value of `subtitle` is `Select one of the following options`

`titleWidth`	Defines the width in pixels of the value of title in the browser window.
	
	Example
	
	`<Display>`
	`<Property name='titleWidth'>`
	`<Integer>120</Integer>`
	`</Property>`
	`</Display>`

The following table lists all elements that can occur within the form body.

Table 2-10 Elements that Can Occur within the Form Body

Component	Definition	Example

`defun`	Defines an XPRESS function. This element can be called by any field element in a form.	`<defun name='add100'>`
		`<def arg name='x'/>`
		`<add><i>x</i><i>100</i>`
		`</add>`
		`</defun>`

Table 2-10 Elements that Can Occur within the Form Body

Component	Definition	Example

`defvar`	Defines an XPRESS variable that is used to hold the results of a computation.	`<defvar name='nameLength'`
		`  <length>`
		`  <ref>fullname</ref>`
		`  </length>`
		`</defvar>`

`Display`	Identifies the display components that will define the appearance of the field. See the section titled Display Element for more information.	`<Display class='LinkForm'>`
		`  <Property name='title' value='User Self Service'/>`
		`  <Property name='subtitle' value='Select one of the following options'/>`
		`</Display>`

`Field`	Main element used within the form body. See the section titled Field Element for more information.	`<Field name='fullname'/>`
`FieldRef`	Provides a reference to a field defined in an included form.	`<FieldRef name='fieldName'/>`

`Include`	Provides a reference to another form object. Once included in the current form, the fields defined in the form can be referenced and displayed.	`<Include>`
		`  <ObjectRef type='UserForm' id='#ID#UserForm:UserFormLibrary'/>`
		`</Include>`

`FormRef`	Provides a reference to another form object.	`<FormRef name='formName'/>`

Table 2-10 Elements that Can Occur within the Form Body

Component	Definition	Example
Namespace	Provides a way to define a shortcut to a view. The shortened name can then be used in field names and references instead of the longer name. When using the name substitution, use a colon (:) following the name.	<Namespace name='w' value='waveset'/>

Form Element

The <Form> element must surround all Field elements and contains the unique name of the form. The elements listed on the previous page are contained within the beginning and ending Form tags.

Code Example 2-5

```
<Form name='Create User Form'
   <Field name='waveset.accountId'>

additional fields

</Form>

Additional example:

<Form name='Task Launch Form'>
   <Display class='EditForm'>
      <Property name='title' value='Task Launch'/>
      <Property name='subTitle' value='Enter task launch parameters'/>
   </Display>
...
</Form>
```

Display Element

A Display element within the Form element describes the component that will be used to render the form. By default, this Display element is the used EditForm component. You will rarely need to change the Form component class, but you can set component properties. The two most common properties to specify are title and subTitle.

EditForm also supports the adjacentTitleWidth property, which can be used to set the width of the titles of adjacent fields. If this property is not defined, it defaults to zero.

If you define adjacentTitleWidth as equal to zero, columns titles will automatically resize. If set to a non-zero value, then the title width of adjacent columns (for example, the second and third columns) will be the value of adjacentTitleWidth.

```
<Form name='Default User Form' help='account/modify-help.xml'>

   <Display class='EditForm'>

     <Property name='titleWidth' value='120'>

     <Property name='adjacentTitleWidth' value='60'>

   </Display>
```

Field Element

The Field element is the main element used within the form body. Fields are used to define each of the user's attributes. You can use Field elements to include XPRESS logic in form fields. For more information on working with form field elements, refer to the section titled *Defining Fields*.

The following example creates an editing field with the label Email address.

```
<Field name='waveset.email'>

   <Display class='Text'>

      <Property title='Email Address'/>

      <Property size='60'/>

      <Property maxLength='128'/>

   </Display>

...

</Field>
```

The name of an editing field is typically a path expression within a view that is being used with the form. In this example, waveset.email refers to the email address associated with a user object in the Identity Manager repository.

Footer

The footer contains information about the Identity Manager object group or organization with which the form is associated. It also contains the closing tags for the `</Form>`, `</Extension>`, and `</Configuration>` elements or other elements opened in the header. The footer in the preceding example is:

```
</Form>

</Extension>

   <MemberObjectGroups>

      <ObjectRef type='ObjectGroup' id='#ID#Top' name='Top'/>

   </MemberObjectGroups>

</Configuration>
```

`<MemberObjectGroups>` identifies the object group or organization into which the system stores an object. If you do not specify an object group, by default the system assigns the object to the `Top` organization. For Configuration objects that contain forms, are typically found in the `All` group with this syntax:

```
<MemberObjectGroups>

   <ObjectRef type='ObjectGroup' name='All'/>

</MemberObjectGroups>
```

What Is a Form Field?

The form body contains `Field` elements that define how each element of the Web page appears and behaves. Each `Field` can contain other fields, each with its own display component.

Form fields comprise several parts, which are encapsulated by the `<Field>` tag set:

- **Value Expressions**. The field can contain a number of XPRESS expressions, which calculate the value of the field or define the set of allowed values. For example, `<Default>` is used to define the default value of a field, and `<Derivation>` is used to derive the value for the field when the form is first loaded. Not all field elements contain expressions. See the section titled Defining Field Names.

- **HTML Display Components**. Display components determine how visible elements are displayed. In Identity Manager form fields, *display components* (defined in the form by the `<Display>` element) determine the behavior and appearance of form fields. You can specify only one display component for each field. These display components are described in detail in Chapter 6, "HTML Display Components."
- **Disable Expressions**. Fields can be conditionally included in the form by using `Disable` expressions. If the `Disable` expression evaluates to true, the field is ignored.

Creating Variables

Use the following syntax to include variables that contain long lists of constant or static data. This syntax builds a static list once and reuses it on each reference

```
<defvar name='states'>
    <List>
      <String>Alabama</String>
            ...
    </List>
</defvar>
```

The former syntax is preferable to `<list><s>Alabama</s>...</list>`, which builds a new list each time it is referenced.

NOTE You must use balanced parentheses in form variable values and when naming Identity Manager objects. If you use parentheses in object names or form variables, they must be balanced (that is, for every '(' there is a corresponding ')'). This allows all form variable expansions to expand properly. (Unbalanced parentheses will result in an error.)

For example, when a resource name contains unbalanced parentheses, you can neither edit or delete the user object of any user to whom this resource has been assigned. However, the pertinent error message will indicate that the failure is caused by unbalanced parentheses in the specific resource name.

Defining Fields

This section describes procedures you perform when customizing any form. These procedures include:

- Defining field names
- Defining field elements
- Adding a visible field
- Hiding a field. When you hide a field, the field (and any fields nested within it) is not displayed on the page, but its value is included in the form processing.
- Disabling a field. When you disable a field, the field (and any fields nested within it) is not displayed in the page, and its value expressions are not evaluated. If the view already contains a value for the disabled field, the value will not be modified.
- Setting a field value
- Calling functions

The following sections discuss in more detail the field characteristics you will set.

Defining Field Names

You use the field name to match the attribute defined on the resource to the text entry field that is displayed on the web page. When the resource is defined, the system sets up a schema map that maps resource account attributes to Identity Manager attributes. For example, your Active Directory resource might have attributes that include `firstname`, `lastname`, and `Office Phone`. When referring to these attributes in the form, you must know the name of the attribute on the Identity Manager schema plus the path to the attribute from the view.

There are two ways of defining the `name` attribute of the `Field` element:

- The `name` attribute typically contains a path to an attribute within the user view.
- The `name` attribute is used to identify the field so that it can be referenced by other fields in the form or by a `FieldRef` element. This occurs when fields are defined to represent containers of other fields and do not correspond to any one attribute of the view.

Determining whether a `Field` name represents a path expression for the view or is simply a reference name depends on the value of the `class` attribute selected in the `Display` element. If the display class is the name of an editing component class, then the name is expected to be a path expression for the view. See the section titled HTML Display Components for a detailed explanation of the component classes.

Creating a Path Expression to a View Attribute

Typically, you define a `Field` name by including the path to an attribute in the user view (the path expression). For a list of these attributes, see Identity Manager Views.

The following field definition renders a text field to edit the Identity Manager email address:

```
<Field name='waveset.email'>
   <Display class='Text'>
      <Property name='size' value='60'/>
   </Display>
</Field>
```

The string `waveset.email` is a path expression for the user view that targets the email address stored in the Identity Manager repository.

Example:

This example field edits the email address defined for a particular resource account. The field name references a resource in the account:

```
<Field name='accounts[Active Directory].email'>
   <Display class='Text'>
      <Property name='size' value='60'/>
   </Display>
</Field>
```

The string `accounts[Active Directory].email` is a path expression to another location within the user view that holds information about account attributes for a specific resource. In this example, the resource named `Active Directory`.

Example:

This example field defines the email address for all resources including Identity Manager that contain an attribute named `email` on the left side of the schema map.

```
<Field name='global.email'>
   <Display class='Text'>
      <Property name='size' value='60'/>
   </Display>
</Field>
```

Identifying the Field for Reference

Naming a field provides you a way to reference the field value in other fields. Use the `<ref></ref>` tag set to reference a field value from another field. The following example concatenates into the `fullname` field the `firstname` and `lastname` field values with a string, a comma, and a space such as: `lastname, firstname`. The `<s>` tag designates a string.

Code Example 2-6

```
<Field name='global.firstname'>
   <Display class='Text'/>
</Field>
<Field name='global.lastname'>
   <Display class='Text'/>
</Field>
<Field name='global.fullname'>
   <Expansion>
      <concat>
         <ref>global.lastname</ref><s>, </s>
         <ref>global.firstname</ref>
      </concat>
   </Expansion>
</Field>
```

Not all `Field` names represent path expressions for the view. Some fields are defined to represent containers of other fields and do not correspond to any one attribute of the view. In these cases, the `Field` name is used to identify the field so that it can be referenced by a `FieldRef` element. If the field does not need to be referenced, you do not need to specify the name.

For example, a form button performs an action, but does not contain a value or need to be referenced by another form. Therefore, it does not need a field name:

```
<Field>
   <Display class='Button'>
      <Property name='label' value='Recalculate'/>
      <Property name='command' value='Recalculate'/>
   </Display>
</Field>
```

For more information on user views, see the section titled User View and Forms.

Field Display Properties

The `Display` element is common to all visible form fields. `Display` elements contain `Property` elements that define the characteristics of the field rendered by the browser. By defining a `Display` element for a form, it will be visible on the screen unless there is a `Disable` element in the field that evaluates to true. There can be conditions in which the form is displayed until another field or value is set and when the form recalculates the field can become hidden from the screen. See the section titled Disabling Fields.

Display

Describes class and properties of the visible field. This element specifies a component class to instantiate and a set of property values to assign to the instance.

```
<Display class='Text'>
   <Property name='size' value='20'/>
   <Property name='maxLength' value='100'/>
</Display>
```

The `class` attribute of the `Display` element must be the name of a `Component` class. By default, these classes are expected to reside in the `com.waveset.ui.util.html` package and include Applet, Button, and DatePicker among others. A list of all the default classes and their descriptions can be found in the *Base Component Class* section of HTML Display Components To reference a class that is not in this package, you must use a fully qualified class name for the `class` attribute. All classes described in this document are in the default package and do not require qualified names.

Property

Occurs within the `Display` element. The `property` value defines the names and values of properties that are to be assigned to the component. The property name is always specified with the `name` attribute.

Specifying Property Values for a Display Element

You can specify the `Property` value for a `Display` element through the use of:

- a `value` attribute
- an XML Object language
- an expression to specify a value

For most property values, you can use the `value` attribute and let the system coerce the value to the appropriate type.

Use of the value Attribute

The most common way of specifying the property value is with the `value` attribute. The value of the `value` attribute is treated as a string, but if necessary, the system will coerce it to the data type desired by the component. In the previous example, the property `size` is set to the integer value 20, and the property `maxLength` is set to the integer value 100.

The following example creates a field that uses `SimpleTable` to organize several subfields. Within XML forms, the most common `Container` components used are `SimpleTable` and `ButtonRow`.

Code Example 2-7

```
<Field name='SelectionTable'>
   <Display class='SimpleTable'>
      <Property name='columns'>
         <List>
            <String>Account</String>
            <String>Description</String>
         </List>
      </Property>

   </Display>
<Field name='accounts[LDAP].selected'>
   <Display class='Checkbox'>
      <Property name='label' value='LDAP'/>
   </Display>
</Field>
<Field>
   <Display class='Label'>
      <Property name='text' value='Primary Corporate LDAP Server'/>
   </Display>
</Field>
<Field name='accounts[W2K].selected'>
   <Display class='Checkbox'>
      <Property name='label' value='Windows 2000'/>
   </Display>
</Field>
<Field>
   <Display class='Label'>
      <Property name='text' value='Primary Windows 2000 Server'/>
   </Display>
</Field>
</Field>
```

Within the `Display` element are zero or more `Property` elements. These define the names and values of properties that are assigned to the component. The `Property` name is always specified with the `name` attribute. The property value is most specified with the `value` attribute. The value of the `value` attribute treated as a string, but if necessary it will be coerced to the data type desired by the component.

Use of XML Object Language

You can also specify property values using the XML Objects language. This approach is useful primarily when specifying list values. This language provides a syntax for describing several standard Java objects as well as other objects defined by Identity Manager.

The more common Java XML objects include:

- `List`
- `Map`
- `MapEntry`
- `String`
- `Integer`
- `Boolean`
- `Object`

When you use the XML Object syntax to specify property values, an element is placed inside the `Property` element. For more information on the XML Object language, see XML Object Language.

Code Example 2-8

```
<Property name='size'>
   <Integer>10</Integer>
</Property>

<Property name='title'>
   <String>New Password</String>
</Property>

<Property name='leftLabel'>
   <Boolean>true</Boolean>
</Property>

<Property name='allowedValues'>
   <List>
      <String>Texas</String>
      <String>Iowa</String>
      <String>Berkshire</String>
   </List>
</Property>
```

All properties that expect list values recognize the `List` element. Most attributes, in addition, recognize the comma list syntax for specifying lists.

Use of an Expression to Calculate the Value

You can also specify a `Property` value through an expression. This allows a value to be calculated at runtime, possibly combining fixed literal values with variable values defined by the page processor. Example:

Code Example 2-9

```
<Property name='title'>
   <concat>
      <s>Welcome </s>
      <ref>waveset.accountId</ref>
      <s>, select one of the following options.</s>
   </concat>
</Property>
```

In the preceding example, `waveset.accountId` is a reference to a variable. When the system generates the HTML for this component, the page processing system supplies the value for the `waveset.accountId` variable. The names of the variables that can be referenced are defined by the page processor. In most cases, these are defined by a *view* that is used with the XML form. Form designers must be aware of the view with which the form will be used and only reference attributes defined by that view.

Disable Element

Calculates a Boolean value. If true, the field and all its nested fields will be ignored during current form processing.

Do not create potentially long-running activities in Disable elements. These expressions run each time the form is recalculated. Instead, use a different form element that will not run as frequently perform this calculation.

NOTE The `display.session` and `display.subject` variables are not available to Disable form elements.

Example

This example illustrates a field definition that uses an expression within the `<Disable>` element to control the visibility of the field. `accountInfo.typeNames` is used to find the type of all resources that a user is assigned to. The type returned is a list of all the user's resource types. If the list of returned type names contains Solaris, then this field is displayed on the screen. Otherwise, this field is disabled.

Code Example 2-10

```
<Field name='HomeDirectory' prompt='Home Directory'>
   <Display class='Text'/>
      <Disable>
         <not>
            <contains>
               <ref>accountInfo.typeNames</ref>
               <s>Solaris</s>
            </contains>
          </not>
   </Disable>
</Field>
```

Disable elements are typically used to check values of other fields on the form. disabling if another field is equivalent to a specific value or not, with null being a special case. Often the other field being referenced is calculated based on other input fields.

Code Example 2-11

```
<Field name='special value subfield'>
   <Comment>Show only when otherField has the value 'special value'
  </Comment>
  <Disable>
    <neq>
      <ref>otherField</ref>
      <s>special value</s>
    </neq>
  </Disable>
...
</Field>
```

Code Example 2-12

```
<Field name='account correlation rule'>
  <Comment>If synchronization on a resource supports an account correlation rule, allow one to be selected,
otherwise don't show the field.  If a process rule has been selected, then a correlation rule won't be run, so don't
show the field.
   </Comment>
  <Disable>
    <or>
      <isnull>
        <ref>resourceAttributes[correlationRule].displayName</ref>
      </isnull>
      <notnull>
        <ref>resourceAttributes[processRule].value</ref>
      </notnull>
    </or>
  </Disable>
...
</Field>
```

Default Element

Calculates a value to be used as the value of this field, but only if the field does not already have a non-null value. `Default` is essentially the same as `Derivation`, except that the value applies only if the current value is non-null. Default expressions are calculated when:

- the form is first loaded
- data is retrieved from one or more resources
- the form is recalculated or saved until the field value is non-null.

Example

This example shows a field definition that uses string manipulation expressions to return a default account ID composed of the first initial of the first name plus the user's last name.

Code Example 2-13

```
<Field name='waveset.accountId'>
   <Display class='Text'>
      <Property name='title' value='AccountID'/>
   </Display>
   <Default>
      <concat>
         <substr>
            <ref>accounts[AD].firstname</ref>
               <i>0</i>
               <i>1</i>
```

Code Example 2-13

```
            <ref>accounts[AD].lastname</ref>
         </substr>
      </concat>
   </Default>
</Field>
```

Derivation Element

Unconditionally calculates a value for the field. Whenever a Derivation expression is evaluated, the current field value is replaced.

`Derivation` expressions are calculated when the form is first loaded or data is returned from one or more resources

The following example shows a field definition that uses *conditional logic* to map one set of values into another set. When this field is processed, the expression in the `<Derivation>` element is evaluated to determine the descriptive value to be displayed for this field based on the location code returned from the resource.

Code Example 2-14

```
<Field name='location'>
   <Display class='Text'>
      <Property name='title' value='Location'/>
   </Display>
   <Derivation>
         <switch>
            <ref>accounts[Oracle].locCode</ref>
            <case>
               <s>AUS</s>
               <s>Austin</s>
            </case>
               <s>HOU</s>
               <s>Houston</s>
            </case>
            <case>
               <s>DAL</s>
               <s>Dallas</s>
            </case>
            <case default='true'>
               <s>unknown</s>
            </case>
         </switch>
   </Derivation>
</Field>
```

Expansion Element

Unconditionally calculates a value for the field. It differs from Derivation in the time at which the expression is evaluated.

Expansion statements are calculated when:

- the page is recalculated
- the form is saved

The following example shows a field definition that uses conditional logic to convert the value derived for the `location` field in the previous example back into a three-letter abbreviation that will be stored on the Oracle resource. Notice the difference in the field names. The location field value is not saved on any resource. It is used to calculate another field.

Code Example 2-15

```
<Field name='accounts[Oracle].locCode'>
   <Expansion>
      <switch>
         <ref>location</ref>
         <case>
            <s>Austin</s>
            <s>AUS</s>
         </case>
         <case>
            <s>Houston</s>
            <s>HOU</s>
         </case>
         <case>
            <s>Dallas</s>
            <s>DAL</s>
         </case>
      </switch>
   </Expansion>
</Field>
```

Validation Element

Determines whether a value entered in a form is valid. Validation rules are evaluated whenever the form is submitted.

This example Validation rule checks to make sure that a user's zip code is five digits.

Code Example 2-16

```
<Validation>
   <cond>
      <and>
      <eq><length><ref>global.zipcode</ref></length>
            <i>5</i>
      </eq>
            <gt><ref>global.zipcode</ref><i>99999</i></gt>
      </and>
      <null/>
      <s>zip codes must be five digits long</s>
   </cond>
</Validation>
```

Editing and Container Fields

When the `Display` element appears with the `Field` element, it describes the component that will be used to render that field. There are two types of fields:

- **editing fields**. These are associated with a particular value to modify.
- **container fields**. These surround one or more fields.

Editing fields must have names and are always used with one of the editing components such as `Text` or `Checkbox`.

Example Editing Field

```
<Field name='waveset.email'>
   <Display class='Text'>
      <Property title='Email Address'/>
      <Property size='60'/>
      <Property maxLength='128'/>
   </Display>
 ...
</Field>
```

The name of an editing field is typically a path expression within a view that is being used with the form. In the preceding example, `waveset.email` refers to the email address associated with a user object in the Identity Manager repository.

A `Container` field may not have a name and is always used with one of the `Container` components, such as `ButtonRow`, `SimpleTable`, or `EditForm`.

One common type of container is the `EditForm` container, which builds an HTML table that contains titles in one column and components in another. These titles are defined in the `title` property and are rendered on the Identity Manager page associated with the form.

Disabling Fields

When you disable a field, the field (and any fields nested within it) is not displayed in the page, and its value expressions are not evaluated or incorporated in to any `global.*` attributes. If the view already contains a value for the disabled field, the value will not be modified.

```
<Disable></Disable>
```

Example

```
<Field name='waveset id'>
   <Display class='Text'>
      <Property title='accountId'>
   </Display>
   <Disable>
      <eq><ref>userExists</ref><s>true</s></eq>
   </Disable>
</Field>
```

NOTE Disable expressions are evaluated more frequently than other types of expression. For this reason, keep any `Disable` expression relatively simple. Do not call a Java class that performs an expensive computation, such as a database lookup.

Use caution when referencing fields with `Disable` rules. Otherwise, fields inside containers might be disabled.

Hiding Fields

When you hide a field, the field (and any fields nested within it) is not displayed on the page, but its value is included in the form processing.

To hide a field, simply do not assign a Display class to the field.

```
<Field name='field A'/>
```

Calculating Field Values

Field values can be calculated from the values of other fields or any logical expression. For example, you can calculate the user's full name from the first name, middle initial and last name.

Code Example 2-17

```
<Field name='global.fullname'>
   <Expansion>
      <concat>
         <ref>global.firstname</ref>
         <s> </s>
         <ref>global.middle</ref>
         <ref>global.lastname</ref>
         <s> </s>
      </concat>
   </Expansion>
</Field>
```

Setting Default Values

You can set the email address based on the user's first initial and the first seven characters of the user's last name. In this example, the system performs an additional check to ensure that the values have been set before performing the concatenation. This additional check is performed to:

- Allow the email address to set only when the account is first created.
- Confirm that the first and last name fields have been set.

Code Example 2-18

```
<Field name='global.email'>
   <Default>
      <and>
         <notnull><ref>global.firstname</ref></notnull>
         <notnull><ref>global.lastname</ref></notnull>
      </and>
         <concat>
         <downcase>
            <substr>
            <ref>global.firstname</ref>
            <i>0</i>
            <i>1</i>
            </substr>
         </downcase>
         <downcase>
            <substr>
            <ref>global.lastname</ref>
            <i>0</i>
            <i>6</i>
            </substr>
         </downcase>
         <s>@waveset.com</s>
      </concat>
   </Default>
</Field>
```

Deriving Field Values

Some fields are used on the form solely to calculate other fields. These fields cannot be stored on any resource to which the user belongs. When the user record is edited, each of the resources is contacted and the field values for the attributes are populated. To populate the fields that are used for calculations, you can write derivation rules.

Example

A phone number field can be represented on the form as a single text box. However, a more advanced form might have three fields for the area code and phone number, which are used to calculate the phone number that is saved to the resource.

In the simple case of representing a phone number, you can have form fields that resemble the ones listed below.

Code Example 2-19

```
<Field name='P1'>
   <Display class='Text'>
      <Property name='title' value='Office Phone Number'/>
      <Property name='size' value='3'/>
      <Property name='maxLength' value='3'/>
   </Display>
</Field>
<Field name='P2'>
   <Display class='Text'>
      <Property name='title' value='-'/>
      <Property name='size' value='3'/>
      <Property name='maxLength' value='3'/>
   </Display>
</Field>
<Field name='P3'>
   <Display class='Text'>
      <Property name='title' value='-'/>
      <Property name='size' value='4'/>
      <Property name='maxLength' value='4'/>
   </Display>
</Field>
<Field name='global.OfficePhone'>
   <Expansion>
      <concat>
         <ref>P1</ref><s>-</s>
         <ref>P2</ref><s>-</s>
         <ref>P3</ref>
      </concat>
   </Expansion>
</Field>
```

Example

The following example expands on the field definition for the field P1 defined above. It defines how a phone number attribute is read into the form, and consequently expands into the three field displays.

Code Example 2-20

```
<Field name='P1'>
   <Display class='Text'>
      <Property name='title' value='Office Number'/>
      <Property name='size' value='3'/>
      <Property name='maxlength' value='3'/>
   </Display>
</Field>
```

When a user enters data into Identity Manager, the form can ensure the data is entered properly. However, Identity Manager cannot ensure that data entered directly into the resource meets the same requirements. For example, over the years, administrators might have entered the phone number as 123-4567 (8 characters), 123-123-4567 (12 characters), or (123) 123-4567 (14 characters).

Example

The definition of the `OfficePhone` field remains the same as described previously, but each of the three fields (`P1`, `P2`, and `P3`) should be updated to use derivation rules, as this example illustrates for the `P1` field.

Code Example 2-21

```
<defvar name='lenOfficePhone'>
   <length><ref>Office Phone</ref></length>
</defvar>
<Field name='P1'>
   <Display class='Text'>
      <Property name='title' value='Office Phone Number'/>
      <Property name='size' value='3'/>
      <Property name='maxLength' value='3'>
   </Display>
   <Derivation>
      <or>
      <cond><eq>
      <ref>lenOfficePhone</ref>
         <s>8</s></eq>
         <s> </s></eq>
      </cond>
      <cond><eq>
         <ref>lenOfficePhone</ref>
            <s>12</s></eq>
               <substr>
               <ref>Office Phone</ref>
               <i>0</i>
               <i>1</i>
               </substr>
      </cond>

      <cond><eq>
         <ref>lenOfficePhone</ref>
         <s>14</s></eq>
            <substr>
               <ref>Office Phone</ref>
               <i>0</i>
               <i>1</i>
            </substr>
      </cond>
      </or>
   </Derivation>
</Field>
```

When you are calculating fields, you must consider the data's current format and quality in the resource. It is much easier to ensure the correct field values when creating new users. It is much harder to get existing data to conform to the field when reading it off the resource. You can use derivation rules for any field to check the format of the attribute as it is being read in.

Recalculating Fields

The system performs field calculations many times when a user is working on a form. The field is calculated when it is first displayed, which sets any default values, and the form is calculated when the user clicks **Save**. Two other actions can cause the form to be evaluated: clicking **Recalculate** on the Edit User page and action fields.

Example

```
<Field>
   <Display class='Button'>
      <Property name='label' value='Recalculate'/>
      <Property name='command' value='Recalculate'/>
   </Display>
</Field>
```

To ensure that the system recalculates the value of a field, set `action` to true in the `Display` class element as shown below:

```
<Display class='Select' action='true'>
```

Add this value only to fields that the user selects or clicks on. Do not add it to test or text area fields. When a field has `action=true` set, the form recalculates this form whenever the field is modified in the browser.

Example

```
<Field name='Region'>
   <Display class='Select' action='true'>
      <Property name='title' value='Geographic Region'/>
      <Property name='allowedvalues' value='North, South,
Central, Midwest'./>
<Property name='nullValue' value='Select a region'/>
   </Display>
</Field>
```

Guidelines for Structuring a Form

Use the following guidelines when creating the structure of your new form or editing an existing form.

- **List field elements in the order in which you want them displayed on the page**. The order of the field elements in the form determines the order in which the elements are displayed in the browser.
- **Place the referenced field before the field referencing it**. If a field has an expression that references a value in another field, place the referencing field *after* the referenced field.
- **Disabled fields are ignored when logically true**. If any field defines a Disable expression, it is evaluated. If the result of the Disable expression is logically true, the field will be ignored during form evaluation.

Optimizing Expressions in Form Fields

Some activities performed in forms can call out to resources external to Identity Manager. Accessing these resources can affect Identity Manager performance, especially if the results are long lists of values (for example, compiling a list of groups or email distribution lists). To improve performance during these types of calls, follow the guidelines in the section titled Using a Java Class to Obtain Field Data.

Example Scenario

The following example illustrates a type of expression optimization.

If you want to query a database for information that is not stored in Identity Manager or accessible as a resource account attribute, follow these general steps:

1. Write a Java class that performs the database access.
2. Define a form field that uses a default expression to call the Java class.
3. Reference the hidden variable.

Using a Java Class to Obtain Field Data

You will need to write a Java class that has methods that can be called to retrieve information. The example in the following section, *Defining a Hidden Form Field*, uses the `getJobGrade` method, which is a custom method. You should locate this custom class in the `idm\WEB-INF\classes\com\waveset\custom` directory structure. (If these directories do not exist on your system, you must create them.)

Follow these guidelines when writing this class:

- If the method performs an expensive operation, such as a database request, you should make the call in the `Default` expression of a hidden form field. This will cause the value to be stored in the view when the form is first loaded. The value can then be referenced many times without incurring database overhead.
- If the method being called has not been declared static, use the new element to instantiate the class first, as shown in the following example.

Defining a Hidden Form Field

First, define a hidden form field that uses a default expression to call the Java class by not including any `Display` class in the field definition:

```
<Field name='jobGrade'>
   <Default>
      <invoke name='getJobGrade'
class='com.waveset.custom.DatabaseAccessor'>
         <ref>waveset.accountId</ref>
      </invoke>
   </Default>
</Field>
     </Derivation>
```

Default expressions are evaluated only if the view does not contain a value for the attribute `jobGrade`. Once the default expression has been run, the result is stored in `jobGrade`, and the expression is not run again.

From the Form Element dialog for the element

1. Select Hidden from the Display Class menu.
2. Click **OK**.

The Hidden display class corresponds to the `<input type=hidden'/>` HTML component. This component supports only single-valued data types because there is no way to reliably serialize and deserialize multi-valued data types.

If you have a List that you want to render it as a string, you must explicitly convert it to a String, as shown in the following example:

```
<Field name='testHiddenFieldList' >
   <Display class='Hidden'/ >
   <Derivation>
     <invoke name='toString'>
       <List>
         <String>aaaa</String> <String>bbbb</String>
       </List>
     </invoke>
   </Derivation>
</Field>
```

Referencing the Hidden Attribute

Once you have defined a hidden attribute, you can reference it in other expressions, such as:

```
<Field name='secureKey'>
   <Disable><lt><ref>jobGrade</ref><i>10</i></lt></Disable>
     ...
</Field>
```

You can use XPRESS `defvar` variables to hold the results of a computation, but the results are typically not as efficient as using a hidden form field.

Note about Optimizing Variables Beyond a Single Iteration

XPRESS variables typically persist for only a single iteration over the form fields. As a result, you can use a variable within an Expansion phase but not on a subsequent Derivation phase. If you need a computed value to remain relevant beyond one field iteration, use a hidden form field instead. Hidden field values are stored in the view and will persist until the editing session is either canceled or saved.

Disabling Automatic Linking of New Resources and Users

Identity Manager provides a way to control the linking of existing accounts when new resources are assigned to a user.

When you assign a new resource to a user, and an account with the assigned ID already exists on the resource, Identity Manager by default automatically links that account to the Identity Manager user and proceeds with provisioning. Alternatively, you can disable this automatic linking and enter an alternative account ID when creating a new account for the user.

There are two ways to control how new accounts are linked to user:

- Enabling manual linking of this information in the user form
- Preventing automatic linking during provisioning

Enabling Manual Linking in the User Form

To enable manual linking,

1. Include a property definition in each user form
2. Reference a field in the standard form library

Step One: Include a Property Definition

Define the property definition at the top of the form as follows:

```
<Form>
   <Properties>
      <Property name='InteractiveLinking' value='true'/>
   </Properties>
   ...
</Form>
```

Step Two: Reference the Field in the Standard Form Library

Add a field reference anywhere in the form. For example,

```
<FieldRef name='DiscoveredAccountFields'/>
```

To reference this field, you must have the following Include statement in your user form. Typically, this Include is present in all user forms.

```
<Include>
   <ObjectRef type='UserForm' name='User Library'/>
</Include>
```

With these form changes in place, Identity Manager checks for existing accounts each time the form is refreshed, and before it is saved. If Identity Manager discovers an existing account, it displays warning messages at the top of the form, and inserts new fields for each discovered account. These new fields include a checkbox that can be used to manually indicate that the account should be linked.

In addition, Identity Manager generates a field for each attribute in the resource's Identity template. With this field, you can specify a different identity for the account. Identity Manager fetches the attribute for the existing accounts and includes it in the view.

You can display these attributes using the `MissingFields` reference or with your own custom fields. You must either supply an alternative identity for an account that does not exist, or check the option to allow the existing account to be linked before the form can be saved.

Preventing Automatic Linking during Provisioning

When performing non-interactive provisioning from a workflow, you can also control whether Identity Manager performs automatic account linking. Passing the `NoLinking` view option to the `checkinView` call prevents automatic linking. You can specify this option in several ways:

- Pass it as an argument to the WorkflowServices method as follows:

```
<Action application='com.waveset.provision.WorkflowServices'>
   <Argument name='op' value='checkinView'/>
   <Argument name='view' value='$(user)'/>
   <Argument name='NoLinking' value='true'/>
</Action>
```

- Setting the option as attributes in the view. In this case, name the view attribute `viewOptions.NoLinking`. You can then set it in a workflow with XPRESS logic like this:

```
<set name='user.viewOptions.NoLinking'>
  <s>true</s>
</set>
```

Preventing an Attribute from being Displayed in Clear Text on Results Pages

Identity Manager displays the value of an attribute in clear text on Results pages, even when you have set the attribute for display with asterisks in an Edit form.

To prevent an attribute from being displayed in clear text on Results pages, you must register it as a secret attribute. To register a secret attribute, add it as follows to the System Configuration object:

```
<Attribute name='secretAttributes'>
   <List>
     <String>email</String>
     <String>myAttribute</String>
   </List>
</Attribute>
```

Calling Resource Methods from Forms

You can invoke methods on a resource from a form by using the `invoke` method.

The `invoke` method is called by specifying the class name and name of the method. Arguments can also be passed to the method within the invoke tags as shown in the following example.

Code Example 2-22

```
<Default>
   <block>
      <defvar name='vmsResName'>
         <index i='0'>
         <ref>accountInfo.accounts[type=vms].name</ref>
         </index>
      <defvar>
         <invoke name='callResourceMethod'class='com.waveset.ui.FormUtil'>
            <ref>display.session</ref>
            <ref>vmsResName</ref>
         <null/>
         </invoke>
</Default>
```

From the Form Element dialog for the field

1. Select Javascript from the Display Class menu.
2. Click **OK**.

Referencing a Form from Another Form

You can reference particular fields in a separate form (rather than a complete form) through the use of the <FormRef> element.

Use the <FormRef> element to include another form from within an external form. The following example calls the form named MissingFields.

```
<FormRef name='MissingFields'/>

   <FieldRef name='AuthenticationAnswers'/>

   <FieldRef name='AccountInformation'/>

   <Field name='waveset.backgroundSave'>

      <Display class='Hidden'/>

   </Field>
```

Referencing Fields from Another Form

You can reference particular fields in a separate form (rather than a complete form) through the use of the <FieldRef> element.

Use the <FieldRef> element to include a specific field from within an external form. Include:

- the name of the form in which the field resides. This form name must be listed in the include section of the form header with the <ObjectRef> element. The property type specifies the name of the form (UserForm) and its unique configuration ID. The name property identifies the name of the field you will later reference.
- the field name itself inserted in the section of the form that matches the location on the page you would like it to be displayed.

```
<Include>
   <ObjectRef type='UserForm'
      id='#ID#04F5F14E01889DFE:2E5C94:F131DD723D:-7FE4'
      name='Password Library'/>
   <ObjectRef type='UserForm'
      id='#ID#04F5F14E01889DFE:2E5C94:F131DD723D:-7FE3'
      name='Account Summary Library'/>
   <ObjectRef type='UserForm'
      id='#ID#UserForm:UserFormLibrary'/>
   <ObjectRef type='UserForm' name='Global Attributes'/>
</Include>
```

In the following example, the field name itself inserted in the section of the form that matches the location on the page you would like it to be displayed.

```
<Field name='global.fullname' hidden='true'>
    <Expansion>
      <cond>
        <and>
          <ref>global.firstname</ref>
          <ref>global.lastname</ref>
        </and>
        <concat>
          <ref>global.firstname</ref>
             <s> </s>
          <ref>global.lastname</ref>
        </concat>
      </cond>
    </Expansion>
</Field>
```

In the following example, the <FieldRef> element identifies the name of the attribute you want to reference.

```
<Field>
    <Disable>
       <isnull>
          <ref>waveset.id</ref>
       </isnull>
    </Disable>
    <FieldRef name='DynamicChangePasswordFields'/>
</Field>
```

Editing a Form

You can edit a form to change its display characteristics or add logical processing to select fields or components. This section divides form-related editing tasks into these two categories:

- **Working with display elements**. This section discusses changing the display characteristics of basic page components when editing an Identity Manager form, especially one that is visible to users. These components include buttons, radio buttons, and checkboxes.

- **Working with hidden components**. These components are the HTML elements you add to Identity Manager forms that are used for background processing or for adding logical processing to visible forms. These elements include the `<Disable>` and `<Expansion>` components and the FormUtil methods.

The HTML components described in this task-oriented section are listed in alphabetical order in HTML Display Components.

Working with Display Elements

The display elements you will most modify or add to an Identity Manager form are buttons, fields, and text entry boxes. Other display elements include tables and section headers.

Any display element that does not have a specified `Display` class will be hidden.

Buttons

To create a typical push button, use the `<Button>` component.

To align multiple buttons in a horizontal row, use the `<ButtonRow>` component.

```
<Field>
   <Display class='Button'>
      <Property name='location' value='true'/>
      <Property name='label' value='Cancel'/>
      <Property name='command' value='Cancel'/>
   </Display>
</Field>
```

To position the button in a button row, include the following code in your button definition: `<Property name='location ' value=' button '/>`. If you do not set this `Property` field, the button will appear in the form in the order in which you include it in the form.

Assigning or Changing a Button Label

When defining a button, its label is identified by the `value` setting in the `label` property as indicated below.

```
<Display class='Button'>
   <Property name='label' value='Cancel'/>
```

The browser displays the preceding code as a button labeled **Cancel**.

Overwriting Default Button Names

Two buttons typically are displayed at the bottom of Identity Manager forms. By default, the buttons are labeled **Save** and **Cancel**. To change the names of these buttons, modify the form as follows:

1. On the line that defines the form name (in the header), change the name field

```
<Form name='Anonymous User Menu'>
```

to

```
<Form name='Anonymous User Menu' noDefaultButtons=true>
```

At the bottom of the form, add the following fields for the **Save** and **Cancel** buttons, and change the labels as desired:

```
<Field>
   <Display class='Button'>
      <Property name='label' value='Submit'/>
      <Property name='name' value='submitButton'/>
      <Property name='value' value='true'/>
      <Property name='command' value='Save'/>
   </Display>
</Field>
<Field>
   <Display class='Button'>
      <Property name='label' value='Cancel'/>
      <Property name='command' value='Cancel'/>
      <Property name='location' value='true'/>
   </Display>
</Field>
```

Command Values and Buttons

NOTE This section is important only if you are building `Button` objects. If you are building components from XML forms, you can assume that the values in the following table are recognized.

All pages in the Identity Manager interfaces have used the post data parameter named *command* as a mechanism to convey which form submission button was pressed. Page processing systems using components are not required to follow the same convention, but there are some components that contain special support for the *command* parameter, in particular the `Button` component.

Some page processing systems, notably the one that processes XML forms, expect the *command* parameter to be used. Further, several command parameter values have been used to indicate particular actions. These values are described in the following table.

Table 2-11 Possible Values for the command Parameter

Parameter	Description
Save	Indicates that the contents of the form should be saved.
Cancel	Indicates that contents of the form should be thrown away.

Table 2-11 Possible Values for the command Parameter

Parameter	Description
Recalculate	Indicates that the form should be refreshed based on entered data.

Any value can be used for the *command* parameter, but you must know which unrecognized command value usually results in a redisplay of the page.

Aligning Buttons with <ButtonRow> Element

To align multiple buttons in a row, use the `ButtonRow` element.

```
<Field name='OrganizeButtons'>
   <Display class='ButtonRow'>
      <Property name='title' value='Choose a Button'/>
   </Display>
<Field name='ChangePassword'>
   <Display class='Button'>
      <Property name='label' value='Change Password'/>
      <Property name='value' value='Recalculate'/>
   </Display>
</Field>
<Field name='ResetPassword'>
   <Display class='Button'>
      <Property name='label' value='Reset Password'/>
      <Property name='value' value='Recalculate'/>
   </Display>
</Field>
```

Text Fields

You can include both single-line and multi-line text entry boxes in a form. To create a single-line text entry field, use the `<Text>` element. To create a multi-line text entry field, use the `<TextArea>` element.

```
<Display class='Text'>

   <Property name='title' value='Zip Code'/>

   <Property name='size' value='10'/>

   <Property name='maxLength' value='10'/>

   <Property name='required' value='true'/>

</Display>
```

Assigning or Changing a Field Label

When defining a text field or area, its label is identified by the `value` property of the `label` property as indicated below.

```
<Display class='Text'>
   <Property name='label' value='Input'/>
```

The browser displays the preceding code as a text entry field labeled `Input`.

Containers

Some display elements are contained within components called *container components*. Container components offer a way to:

- Collect multiple components to visually organize in a particular way. Simple containers can concatenate the components horizontally or vertically. Other containers allow more flexible positioning of components and can add ornamentation around the components.
- Group components that you want to hide or disable on a form.

Creating a container class typically results in the generation of an `HTML table` tag.

Typical container components are described in the following table.

Table 2-12 Typical Container Components

Component	Description
`<SimpleTable>`	Arranges components in a grid with an optional row of column titles at the top
`<ButtonRow>`	Arranges button in a horizontal row. This component is essentially a panel that is preconfigured for horizontal layout.
`<BorderedPanel>`	Positions components into five regions: north, south, east, and west
`<SortingTable>`	Displays a blue and beige table with sortable columns.

Creating a Simple Table

The <SimpleTable> component is a frequently used container component in Identity Manager forms. It arranges components in a grid with an optional row of column titles at the top. The only property for this display component is columns, which assigns column titles and defines the width of the table as defined in a list of strings.

In the following example, a field that uses SimpleTable to organize several subfields:

Code Example 2-23

```
<Field name='SelectionTable'>
   <Display class='SimpleTable'>
      <Property name='columns'>
         <List>
            <String>Account</String>
            <String>Description</String>
         </List>
      </Property>
   </Display>
   <Field name='accounts[LDAP].selected'>
      <Display class='Checkbox'>
         <Property name='label' value='LDAP'/>
      </Display>

   </Field>
   <Field>
      <Display class='Label'>
         <Property name='text' value='Primary Corporate LDAP Server'/>
      </Display>
   </Field>
   <Field name='accounts[W2K].selected'>
      <Display class='Checkbox'>
         <Property name='label' value='Windows 2000'/>
      </Display>
   </Field>
   <Field>
      <Display class='Label'>
      <Property name='text' value='Primary Windows 2000 Server'/>
      </Display>
   </Field>

</Field>
```

Grouping Components

To group multiple components on a form to hide or disable them, use the `<SimpleTable>` container as shown in the following example.

Code Example 2-24 Grouping Components for a Form

```
<Field>
   <Disable>
      <not>
         <contains>
            <ref>accountInfo.typeNames</ref>
            <s>Windows Active Directory</s>
         </contains>
      </not>
   </Disable>
      <Field name='accounts[AD].HomeDirectory'>
         <Display class='Text'>
            <Property name='title' value='Home Directory'>
         </Display>
      </Field>
</Field>
```

Working with Lists

The component you use to create a list depends upon list length and whether the user can select more than one option simultaneously.

Text boxes often supply a list of options from which a user can select. These lists are populated by specifying choices within a property called `allowedValues` or by obtaining values dynamically through a method call (FormUtil class methods) to the resource. For information on populating text areas with lists, see the section titled Populating Lists in this chapter.

The following table describes typical list types and the HTML display components used to create them.

Table 2-13 Typical List Types and Associated Display Components

Type of List	HTML Component
Option list that offers mutually exclusive values such as true and false	`<CheckBox>` See the section titled Creating a Checkbox.

Table 2-13 Typical List Types and Associated Display Components

Type of List	HTML Component
Multiple-option list in which users can select only one option	`<RadioButton>` See the section titled Creating a Radio Button.
Multiple-option list (with many options) in which users can select only one option	`<Select>` See the section titled Creating a Single-Selection List.
Multiple-option list in which multiple options can be selected simultaneously	`<MultiSelect>` See the section titled Creating a Multiselection List.

Creating a Checkbox

Use the `<Checkbox>` component to display a checkbox. When selected, the box represents a value of `true`. A cleared box represents a false value. You can change the checkbox name by editing the value of the `label` property.

Example 1

```
<Field name='accounts[LDAP].selected'>
   <Display class='Checkbox'>
      <Property name='label' value='LDAP'/>
   </Display>
</Field>
```

Example 2

```
<Field name='global.Password.Expired'>
   <Display class='CheckBox'>
      <Property name='title' value='User must change password at
      next login'/>
      <Property name='alignment' value='left'/>
   </Display>
</Field>
```

Creating a Radio Button

Use the <Radio> component to display a horizontal list of one or more radio buttons. A user can select only one radio button at a time. If the component value is null or does not match any of the allowed values, no button is selected.

```
<Field name='global.EmployeeType'>
   <Display class='Radio'>
      <Property name='title' value='EmployeeType'/>
      <Property name='labels' value='Employee, Contractor, Temporary,
Part Time'/>
      <Property name='required' value='true'/>
   </Display>
</Field>
```

Creating a Single-Selection List

Along with the <MultiSelect> component, the <Select> component provides a list of items to select from. With longer lists of values to select from, the radio buttons can begin to take up precious space on a form. Alternatively, select lists can provide a way for the user to select from a long list of possible values. This list supports type-ahead if the list is ordered. You can use the allowedValues property to specify the choices from which the user can pick.

Code Example 2-25

```
<Field name='global.title'>
   <Display class='Select'>
      <Property name='title' value='Title'/>
      <Property name='allowedValues'>
         <List>
         <String>Staff</String>
         <String>Manager</String>
         <String>Director</String>
         <String>VP</String>
         </List>
      </Property>
   </Display>
</Field>
```

Creating a Multiselection List

The <MultiSelect> component displays a multiselection list box. This textbox displays as a two-part object in which a defined set of values in one box can be moved to a selected box. Values for the list box can be supplied by allowedValues elements or obtained dynamically through a method call, such as getResources.

Along with the <Select> component, the <MultiSelect> component can dynamically provide a list of items from which to select. These lists are populated by specifying choices within a property called allowedValues or by obtaining values dynamically through a method call to the resource. For information on populating lists within a multiselection entry box, see the section titled Populating Lists.

Code Example 2-26

```
<Field name='waveset.roles'>
   <Display class='MultiSelect' action='true'>
      <Property name='title' value='Roles'/>
      <Property name='availableTitle' value='Available Roles'/>
      <Property name='selectedTitle' value='Current Roles'/>
      <Property name='allowedValues'>
            <invoke name='getObjectNames' class='com.waveset.ui.FormUtil'>

               <ref>display.session</ref>
               <s>Role</s>
               <ref>waveset.original.roles</ref>
            </invoke>
      </Property>
   </Display>
</Field>
```

Alternative Display Values in a Select List

You can create a Select list that displays a different set of values than the values that will actually be assigned to the field. This is often used to provide more recognizable names for cryptic values, or to perform internationalization. This is accomplished by using the valueMap property to associate the displayed value with the actual value, as shown in the following example:

Code Example 2-27 Changing Values for Select Lists Using the `valueMap` property

```
<Field name='waveset.organization'>
   <Display class='Select'>
      <Property name='title' value='Add Account'/>
      <Property name='nullLabel' value='Select...'/>
      <Property name='valueMap'>
         <list>
            <s>Top</s>
            <s>Top Level</s>
            <s>Top:OrgB</s>
            <s>Ted's Organization</s>
            <s>Top:OrgC</s>
            <s>Super Secret Org</s>
         </list>
      </Property>
   </Display>
</Field>
```

In the preceding example, the value map is specified as a list of pairs of strings. The odd-numbered strings are the actual values that are assigned to this field. The even-numbered strings are the values that are displayed in the select list. For example, if the select list entry `Ted's Organization` is selected, the value of this field becomes `Top:Orgb`.

Populating Lists

Lists are frequently populated with options that are dynamically calculated from information that resides in the user object or an external resource. When creating this type of list, you must first create the HTML list components in the form before populating the list. (For additional information on using the HTML text box components, see the sections titled Creating a Single-Selection List and Creating a Multiselection List.)

There are two ways to populate these lists, including the methods covered in this section:

- Populating lists with the `allowedValues` property
- Using `FormUtil` methods to populate either single-selection or multiselection lists with information dynamically derived from an external resource.

See the section titled *Representing Lists in XML Object Language and XPRESS* for a discussion of the advantages to using XML Object language rather than XPRESS for certain tasks.

Populating Lists of Allowed Values

The most typical way of populating lists in forms is through the use of the `allowedValues` property. From this property, you can specify an optional list of permitted values for `<Select>` and `<MultiSelect>` elements. The value of this component is always a list and usually contains strings.

```
<Field name='department'>
   <Display class='Select' action='true'>
      <Property name='title' value='Department'/>
      <Property name='allowedValues'>
         <List>
         <String>Accounting</String>
         <String>Human Resources</String>
         <String>Sales</String>
         <String>Engineering</String>
         </List>
      </Property>
   </Display>
</Field>
```

Dynamically Populating a Multiselection List of Groups

Multiselection lists typically contain two parts:

- The left side of the list displays the items that are available for selection. These values are defined by the `allowedValues` property. This property can be a list of strings, a list of XML object strings, or a list of strings returned from a call to a Java method.
- The right side of the list displays the items that are currently selected. These values are set by selecting one or more items from the left side's `allowedValues` list and pushing these selections to the selected list. The right side of the list is also populated when the form is loaded and the current settings are retrieved.

Adding a Multiselection List of Groups

To add a multiselection list of groups that is populated dynamically from the resource

- Add groups to the right side of the schema map. The values displayed in the right side of a text area that displays a multiselection list are populated from the current value of the associated view attribute, which you identify through the field name.
- Add the following text to any form, changing only the `Field name`, `prompt`, `availabletitle`, `selectedtitle`, and the `name` of the resource as needed.

NOTE In the following example, the: (colon) that precedes `display.session` indicates that you can ignore the base context of the form and reference objects from the root of the workflow context.

In the following example, the : (colon) that precedes `display.session` indicates that you can ignore the base context of the form and reference objects from the root of the workflow context.

```
<Field name='global.AD Groups'>
  <Display class='MultiSelect' action='true'>
    <Property name='title' value='AD Group Membership'/>
    <Property name='availableTitle' value='Available AD Groups'/>
    <Property name='selectedTitle' value='Selected AD Groups'/>
    <Property name='allowedValues'>
      <invoke class='com.waveset.ui.FormUtil'  name='listResourceObjects'>
        <!-- send session information which will be used by the method to
validate authorization user -->
        <ref>:display.session</ref>
        <!-- resource object type - This will differ from resource to
resource, but common types are account, group, and "distribution list" -->
        <s>Group</s>
        <!—- Name of resource being called -->
        <s>AD Resource Name</s>
        <!-- options map - Some resources have options like the context that
the group is listed in. For example, active directory has multiple
containers. By default, the container used will be the one specified on the
resource. The value can be overridden by specifying it here. If the resource
does not support options, the value should be <null/> -->
        <Map>
         <MapEntry key='context' value='ou=Austin,ou=Texas,dc=Sun,dc=com'/>
        </Map>
        <!-- cacheList - specify true or false whether you would like this
list to appear in the Resource Object List Cache-->
        <s>true</s>
      </invoke>
    </Property>
  </Display>
</Field>
```

NOTES If the resource does not support options, the value of `options map` should be `null`. Some resources have options such as the context that the group is listed in. For example, Active Directory has multiple containers. By default, the container used will be the one specified on the resource. This value can be overridden by specifying it here.

Specify the value of `cacheList` as `true` or `false` to designate whether this list should be stored in the Resource Object List Cache. This will cause the method to be run once, and the results are stored on the server.

Creating a Text Entry Field in a Selection List

There are some conditions under which you'd like to include an option in a selection list in which the user can enter a value instead of choosing from the list. You can create this feature by implementing the three fields as shown in the following example.

- This example creates a selection box with the text string `Other` in it and an adjacent text box. When the user selects the `Other` option from the selection box, the page presents a new field in which the user can enter custom information.
- Implements the `defvar` element to create a variable that defines a list of job positions from which a user can select a relevant position.

NOTE Consider putting into a rule any variables that will be referenced in a form multiple times. In the following example, a list of items to select from is stored in a variable (in the example, `titleList`), which allows the `Derivation` rule to search through it.

The following example is interspersed with descriptive text.

```
<defvar name='titleList'>
  <list>
    <s>Manager</s>
    <s>Accountant</s>
    <s>Programmer</s>
    <s>Assistant</s>
    <s>Travel Agent</s>
    <s>Other</s>
  </list>
</defvar>
```

The next part of this example contains two visible fields called `title` and `otherTitle`. The `otherTitle` field is displayed only if the user chooses the other option on the selection list. The third hidden field is `global.Title`, which is set from either `Title` or `otherTitle`.

The `Title` field is the main field that the user will select from. If the user cannot find the item that he wants in the list, he can select `Other`. This is a transient field and is not stored or passed to the workflow process when you click Save. A Derivation rule is used to send the value from the resource and determine if the value is in the list.

NOTE In the following example, `action` is set to true to ensure that form fields populate automatically.

Code Example 2-28

```
<Field name='Title'>
   <Display class='Select' action='true'>
      <Property name='title' value='Title'/>
      <Property name='allowedValues'>
      <Property name='nullLabel' value='Select …"/>
         <expression>
           <ref>titleList</ref>
         </expression>
      </Property>
   </Display>
   <Derivation>
      <cond>
         <isnull><ref>global.Title</ref></isnull>
         <null/>
      <cond>
         <eq>
            <contains>
               <ref>titleList</ref>
               <ref>global.Title</ref>
            </contains>
            <i>1</i>
         </eq>
         <ref>global.Title</ref>
            <s>Other</s>
      </cond>
      </cond>
   </Derivation>
</Field>
```

The `Other` field will appear on the form only if the user has selected Other from the title field. The value of the `Other` field is set when the form is loaded. It is based upon the value of the `Title` field and the `global.title` field.

Code Example 2-29

```
<Field name='otherTitle'>
    <Display class='Text'>
      <Property name='title' value='Other Title'/>
      <Property name='rowHold' value='true'/>
      <Property name='noWrap' value='true'/>
      <Property name='size' value='15'/>
      <Property name='maxLength' value='25'/>
    </Display>
    <Disable>
      <neq>
        <ref>Title</ref>
        <s>Other</s>
      </neq>
    </Disable>
    <Derivation>
      <cond>
        <eq>
          <ref>Title</ref>
          <s>Other</s>
        </eq>
        <ref>global.Title</ref>
      </cond>
    </Derivation>
</Field>
```

The value of Field is based on the value of the Title field. If the value of this field is set to Other, then the field value is defined by the value of the otherTitle field. Otherwise, it will be the value of the Title field.

Code Example 2-30

```
<Field name='Title'>
   <Expansion>
     <cond>
       <eq>
         <ref>global.fieldTitle</ref>
         <s>Other</s>
       </eq>
       <ref>otherTitle</ref>
       <ref>Title</ref>
     </cond>
   </Expansion>
</Field>
```

Filtering the List of Resource Accounts before Display in a Form

You can filter the list of resource accounts before displaying them in a form. By default, no filters are applied, except with the Change Password Form in the User Interface, which preserves the default behavior of filtering disabled accounts from the list displayed to the user.

This Exclude filter is defined as a Form property. The filter is a list of one or more AttributeConditions that, when evaluated, determine if a given resource account should be excluded from the displayed list.

Forms that Support This Feature

The following Forms support the specification of an Exclude filter as a Form property:

Change Password Form (User Interface)

Administrator Interface Forms:

- Change User Password Form
- Deprovision Form
- Disable Form
- Enable Form
- Rename Form
- Reprovision Form
- Reset User Password Form
- Unlock Form

<Exclude> Property Format

The Exclude Form Property takes the following form:

```
<Configuration wstype='UserForm' ...
   <Extension>
     <Form noDefaultButtons='true'>
  ...
  <Properties>
```

To include disabled resource accounts in the list of displayed accounts, remove the disabled attribute condition from the list.

Code Example 2-31

```
</Property>
<Property name='Exclude'>
 <list>
 <new class='com.waveset.object.AttributeCondition'>
 <s>disabled</s>
 <s>equals</s>
 </new>
 </list>
 </Property>
 </Properties>
 ...
</Form>
</Extension>
</Configuration>
```

Valid View Attributes

The list of valid attribute names are those exposed by the views that are associated with each Form listed above for each instance of a currentResourceAccounts object. Valid attributes include:

- accountDisplayName (string)
- accountId (string)
- directlyAssigned (true/false)
- disabled (yes/no)
- exists (yes/no)
- id (string)
- lastPasswordUpdate (string)
- resource (string)
- selected (true/false)
- type (string)
- userPwdRequired (yes/no)

Example: Excluding an LDAP Resource Type from a List of Resource Accounts

To exclude from the list of any given form all resource accounts of type LDAP that are not directly assigned, set the Exclude property as follows:

Code Example 2-32

```
<Property name='Exclude'>
 <list>
 <new class='com.waveset.object.AttributeCondition'>
 <s>type</s>
 <s>equals</s>
 <s>LDAP</s>
 <s>LDAP</s>
 </new>
 <new class='com.waveset.object.AttributeCondition'>
 <s>directlyAssigned</s>
 <s>equals</s>
 <s>false</s>
 </new>
 </list>
</Property>
```

Calling a FormUtil Method from within the allowedValues Property

From within the `allowedValues` property, you can also call FormUtil methods that permit you to dynamically retrieve and process information from a resource external to Identity Manager, such as a database.

This example shows how to call a FormUtil method to populate a `<Select>` list. In the following example, the method is called from within the `allowedValues` property. The `getOrganizationsWithPrefixes` method (or any FormUtil method) is invoked from within an expression.

Code Example 2-33

```
<Field name='waveset.organization'>
   <Display class='Select'>
      <Property name='title' value='Organization'/>
      <Property name='autoSelect' value='true'/>
      <Property name='allowedValues'>
            <expression>
            <invoke class='com.waveset.ui.FormUtil'
               name='getOrganizationsWithPrefixes'>
               <ref>:display.session</ref>
            </invoke>
            </expression>
```

Code Example 2-33

```
        </Property>
   </Display>
</Field>
```

XPRESS also supports the ability to invoke calls to Java methods from within a resource or ActiveSync adapter. The results of the calls can then be used to populate multiselection or select lists. For information on invoking methods from an expression, see *XPRESS Language*

Creating a Label Field

Labels are useful components for displaying the value of a read-only field. Properties of the `<Label>` component permit you to define the display characteristics of the label, including color, value (string), and font style.

```
<Field>

   <Display class='Label'>

      <Property name='text' value='Primary Corporate LDAP

         Server'/>

   </Display>

</Field>
```

The `value` attribute is always a string.

Working with Other Display Elements

Other display elements that you might want to incorporate into a form include:

- section header
- calendar icon
- back link

Adding a Section Heading to a Form

Section heads are useful to separate sections of long forms with a prominent label. The `<SectionHead>` element displays a new section heading defined by the value of the `title (prompt)` property. It is an extension of the `Label` class that sets the `font` property to a style that results in large bold text. It also sets the `pad` property to zero to eliminate the default two-space padding.

```
<Field>
   <Display class='SectionHead'>
      <Property name='title' value ='Calculated Fields'/>
   </Display>
</Field>
```

Adding a Calendar Icon to a Form

You can add a calendar icon to a page with the DatePicker element. The user can click this icon to select a calendar date and populate a page field. For example, the Identity Manager Create Audit Report page uses this component to select start and end dates.

The DatePicker element returns a date object. Most resource attributes that you set using DatePicker require a date in the form of a string. The extra text field performs the conversion of the new date object into a string or displays the current setting.

You can obtain the date in one of several formats by passing a different format string to the invoke `dateToString` method as indicated in the following table.

Table 2-14 Expiration Date Formats

Expiration Date Field	Format
AIX	MMddHHmmyy
HPUX	MM/dd/yy
Solaris	MM/dd/yyyy

```
<Field name='aix_account_expire'>
   <Display class='DatePicker'>
     <Property name='title' value='Set Password Expiration Date'/>
   </Display>
</Field>
```

The field defined below displays the password expiration date as found in the `/etc/security/user` file. It also displays any new date selected by the `aix_account_expire` field if the refresh or recalculate is performed after selecting a new date. Identity Manager looks to see if the `aix_account_expire` date field has been set (not null) from the DatePicker field.

If this date field has been set, Identity Manager calls an `invoke` method to convert the date object into a string in the specified format: `MMddHHmmyy`.

Otherwise, display the current date as set on the AIX OS: `accounts[AIX].aix_expires`.

Code Example 2-34

```
      <Field name='accounts[AIX].aix_expires'>
        <Display class='Text'>
          <Property name='title' value='Current Password Expiration Date'/>
          <Property name='noNewRow' value='true'/>
          <Property name='readOnly' value='true'/>
          <Property name='size' value='10'/>
        </Display>
        <Expansion>
          <cond>
            <notnull>
              <ref>aix_account_expire</ref>
            </notnull>
            <invoke name='dateToString' class='com.waveset.util.Util'>
            <!-- First argument to dateToString method is a date object -->
              <ref>aix_account_expire</ref>
            <!-- Second argument is the format you want the converted date/string in
-->
                <s>MMddHHmmyy</s>
            </invoke>
            <ref>accounts[AIX].aix_expires</ref>
          </cond>
        </Expansion>
      </Field>
```

Adding a Back Link

You can add a component that behaves the same as the browser **Back** button. This component permits you to add a back link anywhere on the form.

```
<Field name='back'>
   <Display class='BackLink'>
      <Property name='title' value='Back'/>
      <Property name='value' value='previous page'/>
   </Display>
</Field>
```

Positioning Components on a Form

The location of a component on a form is determined by the following factors:

- **The Java Service Page (JSP) associated with this form**. The title and subtitle of the form can be set here.
- **Order in which the components are listed in the form**. The browser will display form fields in the order in which they are included in the form.
- **Use of container forms**. For example, to create a vertical row of buttons, use the `<ButtonRow>` container component.

Using Hidden Components

Many forms are not visible to the user but help process data from an external resource through the resource adapter before passing it into Identity Manager. In visible forms, too, some components can be hidden. These hidden components are used to process this incoming data as well as to transform data in visible forms.

Some hidden processing within forms is carried out by the methods in the FormUtil Java class. These are frequently used when populating lists in forms from information retrieved dynamically from an external resource.

This section discusses the following tasks, which permit you to process data and optionally hide this processing in forms. Typical tasks include:

- Including XPRESS Logic Using Derivation and Expansion elements
- Calling Methods to Populate Lists
    - Building DN strings
    - Getting a list of object types for which the session owner has access

- Getting a list of organizations
- Getting a list of unassigned resources
- Obtaining a list of resource object names

- Disabling components
- Hiding components

Including XPRESS Logic Using the Derivation and Expansion Elements

Typically, a field will have either a `Derivation` rule or an `Expansion` rule. If a field includes both types of rules, make sure that these fields do not conflict with each other.

You implement the `<Expansion>` and `<Derivation>` components to use XPRESS to calculate values for form fields. These expressions are similar, differing only in the time at which the expression is evaluated. Derivation rules are typically used to set the value of the field when the form is loaded. Expansion rules are used to set the value of the field whenever the page is recalculated or the form is saved.

Table 2-15 Derivation and Expansion Expressions

Component	Description	Evaluation
`<Derivation>`	Unconditionally calculates an arbitrary value to be used as the value of this field. Whenever a Derivation expression is evaluated, the current field value is replaced.	Derivation rules are run when the form is first loaded or data is fetched from one or more resources.
`<Expansion>`	Unconditionally calculates a value for the field	Expansion rules are run whenever the page is recalculated or the form is saved. For all forms except the User view, Expansion rules are run whenever the page is recalculated or the form is saved. For the User view, an `<Expansion>` tag runs when the user form is first loaded as well.

Table 2-15 Derivation and Expansion Expressions

Component	Description	Evaluation
<Validation>	Determines whether a value entered in a form is valid.	Validation rules are evaluated whenever the form is submitted.

Examples of <Derivation> Statements

The following two examples illustrate the potential use for the Derivation

- Example 1: Specifying an authoritative source for a global field
- Example 2: Mapping one set of values into another set

Example 1:

The following example uses the first value, if defined. If the first value is not defined, then it uses the second value.

```
<Derivation>
   <or>
      <ref>accounts[AD].fullname</ref>
      <ref>accounts[LDAP].fullname</ref>
   </or>
</Derivation>
```

Example 2;

The following example of using the <Derivation> element shows a field definition that uses *conditional logic* to map one set of values into another set.

In this example, the resource account attribute accounts[Oracle].locCode is evaluated against the AUS case element first. If it is true, then the second value is the value returned and displayed in the location field. If no cases are matched, then the value of the default case is returned. When a matching abbreviation is found as the first expression within a case expression, the value of the second expression within the case expression is returned as the result of the switch expression.

Code Example 2-35

```
<Field name='location' prompt='Location'>
   <Display class='Text'/>
      <Derivation>
      <switch>
            <ref>accounts[Oracle].locCode</ref>
            <case>
               <s>AUS</s>
               <s>Austin</s>
            </case>
            <case>
               <s>HOU</s>
               <s>Houston</s>
            </case>
            <case>
               <s>DAL</s>
               <s>Dallas</s>
            </case>
            <case default='true'>
               <s>unknown</s>
            </case>
      </switch>
      </Derivation>
</Field>
```

Examples of <Expansion> Statement

The following two examples illustrate the potential use for the `Expansion` element.

- Example 1: Implementing a rule to standardize the case of text entered in a field
- Example 2: Hiding expansion logic

Example 1:

Expansion rules transform information that has been entered into a field into values that match the format expected by the resource or established by a rule. For example, a free-form text box in which a user enters a name can include an `Expansion` rule that capitalizes the first initial and lowercases the others.

The use of the global attribute in fields sets any of the resources that have this value when the form is saved. When you load this form, Identity Manager loads the values from each resource (unless the field is disabled). The last resource load sets the value in the form. If a user has made a local change, this change may not show up. Consequently, to ensure that the correct value for the attribute is used, you can use a `Derivation` rule to specify one or more of the resources as an authoritative source for the field.

Code Example 2-36

```
<Field name='global.lastname'>
   <Display class='Text'>
       <Property name='title' value='Last Name'/>
       <Property name='size' value='32'/>
       <Property name='maxLength' value='128'/>
       <Property name='noNewRow' value='true'/>
       <Property name='required'>
         <Boolean>false</Boolean>
       </Property>
   </Display>
        <Expansion>
          <block>
            <defvar name='lname'>
              <downcase>
                <ref>global.lastname</ref>
              </downcase>
            </defvar>
            <defvar name='nlength'>
              <sub>
                <length>
                  <ref>global.lastname</ref>
                </length>
                <s>1</s>
              </sub>
            </defvar>
            <concat>
              <substr>
                <upcase>
                  <ref>global.lastname</ref>
                </upcase>
                <s>0</s>
                <s>1</s>
              </substr>
              <substr>
                <ref>lname</ref>
                <s>1</s>
                <ref>nlength</ref>
              </substr>
            </concat>
          </block>
</Field>
```

As the preceding XPRESS logic could be implemented in multiple fields, consider presenting it in a rule.

Example 2:

In the following example, this field is also hidden by the absence of any `Display` class definition. The lack of `Display` class definition prevents the field from being displayed in the form, but the field is still considered to be an active part of the form and will generate values for resource attributes through its `<Expansion>` expression.

```
<Field name='accounts[Oracle].locCode'>
   <Expansion>
      <switch>
         <ref>location</ref>
            <case>
               <s>Austin</s>
               <s>AUS</s>
            </case>
            <case>
               <s>Houston</s>
               <s>HOU</s>
            </case>
            <case>
               <s>Dallas</s>
               <s>DAL</s>
            </case>
      </switch>
   </Expansion>
</Field>
```

In this example, it performs the reverse of the mapping performed by the `location` field.

Example of <Validation> Statement

Validation expressions allow you to specify logic to determine whether a value entered in a form is valid.

The validation expression returns null to indicate success, or a string containing a readable error message to indicate failure. The system displays the validation error message in red text at the top of the form.

The following example contains the logic to determine whether the age entered by user in a field is greater than 0. This expression returns null if the age is greater than or equal to zero.

```
<Field name='age'>
   <Validation>
     <cond>
       <lt>
         <ref>age</ref>
         <i>0</i>
       </lt>
       <s>Age may not be less than zero.</s>
     </cond>
   </Validation>
</Field>
```

Calling Methods to Populate Lists

Lists in single-selection and multiselection text boxes are often populated with choices that are derived from information from external resources. You can populate lists dynamically with this information by calling one of the FormUtil methods supplied by Sun. These common methods can perform the following tasks:

- Obtain a list of resource object names
- Obtain a List of Resource Objects without Map Options
- Build DN strings
- Retrieve a list of accessible object types
- Retrieve a list of object types accessible by the session owner
- Get a list of organizations with prefixes
- Get a list of organizations without prefixes
- Get a list of organizations display names with prefixes
- Retrieve a list of applications unassigned to the user

For information on the `<Select>` and `<MultiSelect>` components and the `allowedValues` property, see the section titled Populating Lists.

Understanding Resource Object Names

To search for or request information on a resource and import it into Identity Manager, you must use object definitions supported by Identity Manager.

The following table lists the object types supported by Identity Manager.

Table 2-16

Supported Object Types	Description
account	List of user accounts IDs
Administrator_Groups	Names of the administrative groups to which a user can belong
Applications	List of applications
Distribution Lists	List of email distribution aliases
Entitlements	List of PKI entitlements
group	List of security and distribution list group objects
Group	Security groups
Nodes	List of SP2 nodes
PostOffices	List of GroupWise post offices
profile	List of top secret profiles
PROFILE	List of Oracle profiles from the DBA_PROFILES table
ROLE	List of Oracle roles from the DBA_ROLES table
shell	List of available UNIX shells
Template	List of NDS Templates
USERS	List of Oracle profiles from the DBA_USERS table
UnassignedTokens	List of available unassigned tokens
User_Properties	List of user property definitions (properties that can be set on the user)

Obtaining a List of Resource Object Names

To obtain a list of object names defined for your particular resource, use the `listResourceObjects` method. You can obtain a list with or without map options. Map options are used only on resources that have a directory structure that permit the filtering of returned values to a single container instead of returning the complete list.

To ensure that you get the resource object list from the resource and not from the server's cache, first invoke the `clearResourceObjectListCache()` method or set the *cacheList* argument to false. However, using the cache improves performance on large lists. The resource is contacted only once, and the results are stored on the cache. Consequently, Sun recommends using the cache.

In addition, you can specify a set of one or more key/string value pairs that are specific to the resource from which the object list is being requested.

The following table lists the object types that are supported by each resource.

Table 2-17 Supported Object Types

Resource	Supported Object Types
AIX	account, Group
ACF2	account
ClearTrust	account, Group, group, Administrator_Groups, Applications, Entitlements, User_Properties
Entrust	Group, Role
GroupWise	account, Distribution Lists, PostOffices
HP-UX	account, Group, shell
LDAP	account, Group
Oracle	USERS, ROLE, PROFILE
NDS	account, Group
PeopleSoft	account
RACF	account, Group
SAP	account, table, profiles, activitygroups
SecurID	UnassignedTokens
SP2	Nodes
Solaris	account, Group, shell
TopSecret	account
VMS	account

Table 2-17 Supported Object Types

Resource	Supported Object Types
Windows Active Directory	account, Group You can specify any Active Directory valid object class name as an object type. (A list of object class names can be found in the Active Directory schema documentation.) The list returned contains the distinguished names of the objects. By default, the method searches in the container that is specified by the Container resource attribute. However, you can specify a container as an option to the `listResourceObjects` call. Its value should be the distinguished name of a container. Only objects within that container are listed.

Obtaining a List of Resource Objects without Map Options

To obtain a list of resource objects without map options, specify the resource object type and resource name. Note: Some resources support acting on a subset of a list. You can do this by specifying a starting directory.

In the following example:

- The `<UnassignedTokens>` string identifies the resource object type that you want to get. Other common resource object types are groups, distribution lists, and accounts.
- The `<SecurID>` string identifies the resource from which the object type is retrieved.
- `null` value indicates no map options.

- value of `true` tells the server to cache the results.

```
<invoke name='listResourceObjects'
   class='com.waveset.ui.FormUtil'>
      <ref>:display.session</ref>
      <s>UnassignedTokens</s>
      <s>SecurID</s>
      <null/>
      <s>false</s>
</invoke>
```

Obtaining a List of Resource Objects with Map Options

To obtain a list of resource objects with map options, specify the resource object type, resource name, and a map option that defines the directory to start the search in. The resource must be directory-based.

For example, you can get a list of all Active Directory groups in the Software Access directory by building a map option that performs the search in the directory path (`ou=Software Access, dc=mydomain, dc=com`).

Example:

In the following example

- The `Group` string identifies the resource object type that you want to get. Strings that identify resource object types are identified in the table titled Available Resource Object Types.
- The `AD` string identifies the resource name from which to retrieve the object type. Map options specify the directory from which to retrieve the list.
- A value of true tells the server to cache the results.
- A value of false tells the server not to cache the results.

```
<invoke name='listResourceObjects'
      class='com.waveset.ui.FormUtil'>
         <ref>:display.session</ref>
            <s>Group</s>
            <s>AD</s>
         <Map>
            // This allows you to return a list of groups only in
            and below the specified container/organizational
            unit
```

```
         <MapEntry key='container'
         value='LDAP://hostX.domainX.com/cn=Users,dc=domainX,dc=com'/>
         </Map>
            <s>false</s>
</invoke>
```

Building DN Strings

With a given user ID and base context, you can dynamically build a list of distinguished names or a single distinguished name. This method does not return a list and is typically used within an Expansion rule.

Building a Dynamic List of DN strings

You can dynamically build a list of DN strings if you specify a user ID and base context.

The following example shows how to use user IDs and base context to build a dynamic list of DN strings.

The following code first defines the base context to append to users.

```
<Field name='baseMemberContextContractor'>
   <Default>
      <s>ou=Contractors,dc=example,dc=com</s>
   </Default>
</Field>

<Field name='baseMemberContextEmployee'>

   <Default>
      <s>ou=Employees,dc=example,dc=com</s>
   </Default>
</Field>
```

The user of this form enters data in the following field. This is a likely place for providing a dynamically generated list of user IDs.

```
<Field name='userIds'>

   <Display class='TextArea'>

      <Property name='title' value='UserIds'/>

   </Display>

</Field>
```

The following hidden field includes logic that calculates values.

```
<Field name='Members'>
   <Expansion>
      <switch>
      // Look at the role assigned to the users
      <ref>waveset.role</ref>
      <case>
      // If user has "Contractor Role" then build DN like this:
      // ex: CN=jsmith,ou=Contractors,dc=example,dc=com
         <s>Contractor Role</s>
         <invoke name='buildDns' class='com.waveset.ui.FormUtil'>
            <ref>userId</ref>
            <ref>baseMemberContextContractor</ref>
         </invoke>
      </case>
      <case>
// Otherwise, if user has "Employee Role", then build DN like this:
         // ex: CN=jdoe,ou=Employees,dc=example,dc=com
         s>Employee Role</s>
         <invoke name='buildDns' class='com.waveset.ui.FormUtil'>
            <ref>userId</ref>
            <ref>baseMemberContextEmployee</ref>
         </invoke>
         </case>
      </switch>
   </Expansion>
</Field>
```

Building a Single DN String

You can call the `buildDn` method to populate a list or text area with a single DN. Example:

```
<invoke name='buildDn' class='com.waveset.ui.FormUtil'>
   <s>jdoe</s>
   <s>dc=example,dc=com</s>
</invoke>
```

This example returns `CN=jdoe,dc=example,dc=com`.

Getting a List of Unassigned Resources

To retrieve a list of all resources to which the user ID could potentially have permission to view but is currently unassigned, call the `getUnassignedResources` method.

The `<ref>` statements identify the view attribute that contains information about the specified user. Example:

```
<invoke name='getUnassignedResources' class='com.waveset.ui.FormUtil'>
   <ref>:display.session</ref>
   <ref>waveset.role</ref>
   <ref>waveset.original.resources</ref>
</invoke>
```

Retrieving a List of Accessible Object Types

To get a list of object types that the session owner currently has access to, use the `getObjectNames` method.

You can request the following object types:

- Account
- Administrator
- Configuration
- EmailTemplate
- Resource
- Role
- System

- TaskInstance
- User
- UserForm

For a complete list of object types, see the List Objects option on the Debug page. Example:

```
<invoke name='getObjectNames' class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

   <s>UserForm</s>

</invoke>
```

Retrieving a List of Object Types Accessible by the Session Owner

To get a list of object names for which the session owner has access, use the `getObjectNames` method. Example:

```
<invoke name='getObjectNames' class='com.waveset.ui.FormUtil'>

  <ref>:display.session</ref>

</invoke>
```

Getting a List of Organizations with Prefixes

To get a list of organizations with prefixes (for example, TOP, TOP:IT, TOP:HR), use the `getOrganizationsWithPrefixes` method. Example:

```
<invoke name='getOrganizationsWithPrefixes'
 class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

</invoke>
```

Getting a List of Organizations without Prefixes

To retrieve a list of organizations without prefixes (for example, TOP, TOP, TOP), use the `getOrganizations` method. Example:

```
<invoke name='getOrganizations' class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

</invoke>
```

Getting a List of Organizations Display Names with Prefixes

To retrieve a list of organization display names with prefixes, use the `getOrganizationsDisplayNamesWithPrefixes` method.

```
<invoke name='getOrganizationsDisplayNamesWithPrefixes'
 class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

</invoke>
```

Retrieving a List of Applications Unassigned to the User

To get a list of applications to which the user is not currently assigned, use the `getUnassignedApplication` method. Example:

```
<invoke name='getUnassignedApplications' class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

   <ref>waveset.roles</ref>

   <ref>waveset.original.applications</ref>

</invoke>
```

Constructing Hash Maps

The `listResourceObjects` and `callResourceMethods` methods accept hash maps. You can construct hash maps with the `<Map>` element.

In the following example, the `<Map>` element builds a static map that never changes.

```
  <Map>

     <MapEntry name='key1' value='value1'/>

     <MapEntry name='key2' value='value2'/>

  </Map>
```

You can also construct maps with an XPRESS expression through the use of the `<map>` element. You can use the `<map>` element to dynamically build a map whose contents are defined by other expressions.

For information on using the XPRESS language to construct a map, see *XPRESS Language*

Disabling Fields

When you disable a field, the field (and any fields nested within it) is not displayed in the page, and its value expressions are not evaluated. If the view already contains a value for the disabled field, the value will not be modified.

```
<Disable></Disable>
```

NOTE Keep in mind that `global.*` attributes are derived from enabled fields only. If a form dynamically disables a field (instead of hiding it), this field value will not be available through the `global.*` attributes.

Example:

```
<Disable>
   <eq><ref>userExists</ref><s>true</s></eq>
</Disable>
```

NOTE Disable expressions are evaluated more frequently than other types of expression. For this reason, keep any `Disable` expression relatively simple. Do not call a Java class that performs an expensive computation, such as a database lookup.

Hiding Fields

When you hide a field, the field (and any fields nested within it) is not displayed on the page, but its value is included in the form processing.

To hide a field, specify that a particular field is hidden by not defining a `Display` property for the field. (This is not conditional.)

```
<Field name='field A'/>
```

Calculating Values

Methods for dynamically calculating values within forms include:

- Generating field values
- Including rules in forms

- Including XPRESS statements in a form

Generating Field Values

In some forms, you might want to first display a set of abstract derived fields to the user, then generate a different set of concrete resource account attribute values when the form is submitted. This is known as *form expansion*. Expanded fields are often used in conjunction with derived fields.

Including Rules in Forms

In forms, you typically call a rule to calculate the `allowedValues` display property or within a `<Disable>` expression to control field visibility. Within forms, rules could be the most efficient mechanism for storage and reuse of:

- a list of corporate departments
- default values
- a list of office buildings

For a comprehensive discussion of rules, see the chapter titled *Rules* in *Identity Manager Deployment Tools*

Including XPRESS Statements

The XPRESS language is an XML-based expression and scripting language. Statements written in this language, called *expressions*, are used throughout Identity Manager to add data transformation capabilities to forms and to incorporate state transition logic within Identity Manager objects such as Workflow and forms.

XPRESS is a *functional* language that uses syntax based on XML. Every statement in the language is a function call that takes zero or more arguments and returns a value. Built-in functions are provided, and you can also define new functions. XPRESS also supports the invocation of methods on any Java class and the evaluation of Javascript within an expression.

For a comprehensive discussion of XPRESS features, see XPRESS Language

Why Use XPRESS?

Expressions are used primarily for the following Identity Manager tasks:

- **Customizing the end-user and administrator forms**. Forms use XPRESS to control the visibility of fields and to transform the data to be displayed and saved.

- **Defining flow of control in Workflow**. Workflow uses XPRESS to define *transition conditions*, which determine the order in which steps in the workflow process are performed.
- **Implementing workflow actions**. Workflow actions can be implemented using XPRESS. Action expressions can perform simple calculations, or call out to Java classes or JavaScript to perform a complex operation.

The expressions contained in these elements can be used throughout Identity Manager.

Example Expression

In the following example, the `<add>` element represents a call to the XPRESS function named `add`.

```
<add> <ref>counter</ref> <i>10</i> </add>
```

This function is passed two arguments:

- *first argument* – value is determined by calling a function named `ref`. The argument to the `ref` function is a literal string that is assumed to be the name of a variable. The value returned by the `ref` function is the current value of the variable *counter*.
- *second argument* -- value is determined by calling a function named `i`. The argument to the `i` function is a literal string that is an integer. The value that the `i` function returns is the integer 10.

The value returned by the `add` function will then be the result of adding the integer 10 to the current value of the variable *counter*. Every function call returns a value for the next operation to use. For example, if the `ref` call returns the value of the counter, then the `<i>` call returns the integer `10`, then the `<add>` call returns the addition of the two calls.

Example of Expression Embedded within Form

The following example shows the use of XPRESS logic embedded within an Identity Manager form. XPRESS is used to invoke one of the FormUtil Java methods that will produce the relevant role-related choices for display in the browser. Note that the expression is surrounded by the `<expression>` tag.

```
<Field name='waveset.role'>
   <Display class='Select' action='true'>
      <Property name='title' value='Role'/>
      <Property name='nullLabel' value='None'/>
      <Property name='allowedValues'>
```

```
        <expression>
           <invoke class='com.waveset.ui.FormUtil' name='getRoles'>
           <ref>:display.session</ref>
       <ref>waveset.original.role</ref>
           </invoke>
        </expression>
      </Property>
  </Display>
</Field>
```

Edit User Form

Identity Manager can identify in the display whether an attribute in a resource's schema map is required. Edit User form identifies these attributes by a * (asterisk). By default, Identity Manager displays this asterisk after the text field that follows the attribute name.

To customize the placement of the asterisk, follow these steps:

1. Using the Identity Manager IDE or your XML editor of choice, open the Component Properties configuration object.
2. Add `EditForm.defaultRequiredAnnotationLocation=left` to the `<SimpleProperties>` tag.

   Valid values for `defaultRequiredAnnotationLocation` include `left`, `right`, and `none`.
3. Save your changes, and restart your application server.

Adding Guidance Help to Your Form

Identity Manager supplies two types of online help:

- Help, which is task-related help and information available from a button in the Identity Manager masthead. You cannot configure this help.
- Guidance (pop-up help), which is field-level help that is available left of the field or area that is marked with a guidance icon .

How to Specify Guidance Help for a Component

You can associate guidance help text with any component, although it is currently displayed only by the `EditForm` container. You can specify guidance text by associating it with the component by matching the component's `title` property with an entry in a help catalog. See the section titled *Matching the Component's title Property with a Help Entry*.

Matching the Component's title Property with a Help Entry

You can automatically associate help catalog entries with components by using key values in the catalog that are the same as component titles appended with the suffix _HELP. For example, the help catalog entry for the _FM_DELEGATEWORKITEMSFORM_SELECT_WORKITEM_TYPE key is _FM_DELEGATEWORKITEMSFORM_SELECT_WORKITEM_TYPE_HELP. When using XML forms, a component title can be specified explicitly with a `Property` element. Otherwise, it will be taken from the value of the `prompt` attribute of the containing `Field` element.

Overriding Guidance Help

You can use a custom message catalog to override the guidance text that displays in a pop-up window. If you name your custom message catalog defaultCustomCatalog, Identity Manager recognizes and uses it automatically. Alternatively, you can choose a different name, and then specify that name in System Configuration object under the customMessageCatalog name

For example:

```
<Attribute name='customMessageCatalog' value= 'sampleCustomCatalog' />
```

The following sample sets custom guidance help for a component called `_FM_DELEGATEWORKITEMSFORM_SELECT_WORKITEM_TYPE`.

```
<Waveset>
   <Configuration name="sampleCustomCatalog">
      <Extension>
         <CustomCatalog id="defaultCustomCatalog" enabled="true">
            <MessageSet language="en" country="US">
            <Msg id="_FM_DELEGATEWORKITEMSFORM_SELECT_WORKITEM_TYPE">Select
Work Item Type</Msg>
            <Msg id="_FM_DELEGATEWORKITEMSFORM_SELECT_WORKITEM_TYPE_HELP>Type
of Work Item: Select a work item type from the list.</Msg>
            </MessageSet>
         </CustomCatalog>
      </Extension>
   </Configuration>
</Waveset>
```

Other Form-Related Tasks

Miscellaneous form-related tasks include:

- Invoking the FormUtil methods
- Inserting Javascript into a form
- Testing whether a user or object exists
- Inserting Alert Messages into XPRESS Forms

Invoking the FormUtil Methods

The FormUtil class is a collection of utility methods that you can call from XPRESS expressions with form objects. They can be used to populate lists of allowed values and validate input. The FormUtil methods are typically called to assist the definition of the allowed values in a list or field.

```
<invoke class = 'com.waveset.ui.FormUtil'
   name = 'listResourceObjects'>
</invoke>
```

where the `name` field identifies the name of the method.

For examples on using these methods within forms, see the section titled *Using Hidden Components*.

Inserting JavaScript into a Form

To insert pre-formatted Javascript into a form, use the `<script>` component as follows:

```
<Field>
  <Expansion>
    <script>
     ............
```

Testing if an Object or User Exists

You might want to check whether an object exists before performing an action. For example, you could look to see if a user name exists in Identity Manager before creating a new user, or validate whether a manager name entered in a field is valid.

To test if an object exists, use the `testObject` method. To specify an object type when using this method, use the object types listed in the section titled *"Retrieving a List of Accessible Object Types" on page 162*. In the following example, the user type is identified as `<s>User</s>`. The second string gives the value of the object type (in this example, `jdoe`).

Example:

```
<invoke name='testObject' class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

   <s>User:</s>

   <s>jdoe</s>

</invoke>
```

The `testObject` method returns true on successful find of an object. Otherwise, this method returns null.

To test if a user exists, use the `testUser` method. The `<s>` element identifies the name of the user object to find. Example:

```
<invoke name='testUser' class='com.waveset.ui.FormUtil'>

   <ref>:display.session</ref>

   <s>jdoe</s>

</invoke>
```

This method returns true on successful find. Otherwise, this method returns null.

Inserting Alert Messages into XPRESS Forms

You can insert WARNING), error (ERROR), or informational (OK) alert messages into an XPRESS form.

NOTE Although this example illustrates how to insert a Warning ErrorMessage object into a form, you can assign a different severity level.

1. Use the Identity Manager IDE to open the form to which you want to add the warning.
2. Add the `<Property name='messages'>` to the main EditForm or HtmlPage display class.

3. Add the <defvar name='msgList'> code block from the following sample code.

4. Substitute the message key that identifies the message text to be displayed in the Alert box in the code sample string:

   <message name='UI_USER_REQUESTS_ACCOUNTID_NOT_FOUND_ALERT_VALUE >

5. Save and close the file.

Code Example 2-37

```
<Display class='EditForm'>
   <Property name='componentTableWidth' value='100%'/>
   <Property name='rowPolarity' value='false'/>
   <Property name='requiredMarkerLocation' value='left'/>
   <Property name='messages'>
     <ref>msgList</ref>
   </Property>
</Display>
<defvar name='msgList'>
  <cond>
    <and>
      <notnull>
        <ref>username</ref>
      </notnull>
      <isnull>
        <ref>userview</ref>
      </isnull>
    </and>
    <list>
      <new class='com.waveset.msgcat.ErrorMessage'>
        <invoke class='com.waveset.msgcat.Severity' name='fromString'>
           <s>warning</s>
        </invoke>
        <message name='UI_USER_REQUESTS_ACCOUNTID_NOT_FOUND_ALERT_VALUE'>
          <ref>username</ref>
        </message>
      </new>
    </list>
  </cond>
</defvar>
```

To display a severity level other than warning, replace the <s>warning</s> in the preceding example with either of the these two values:

- error -- Causes Identity Manager to render an InlineAlert with a red "error" icon.
- ok -- Results in an InlineAlert with a blue informational icon for messages that can indicate either success or another non-critical message.

Identity Manager renders this as an InlineAlert with a warning icon

```
<invoke class='com.waveset.msgcat.Severity' name='fromString'>
<s>warning</s>
</invoke>
```

where `warning` can also be `error` or `ok`.

Wizard and Tabbed Forms

Both wizard and tabbed forms are mechanisms for structuring unwieldy, single-page forms into more easily managed, multiple-paned forms. Both contain separators between logical sections, or pages. These page separators can be tabs located at the top of the form -- like the tabbed user form -- or a wizard form, which guide the user through the pages using the next/back navigation buttons.

See Tabbed User Form in this chapter for the XML version of the default Tabbed User Form.

What Is a Wizard Form?

Wizard forms can be a convenient alternative to launching multiple forms from a task when:

- Transition logic between pages is simple
- Privileged system calls between pages are required

Wizard forms contain the two rows of buttons described below.

Table 2-18 First Row of Buttons

Row of buttons	Description
top row	Next and Back buttons to traverse through the form panes
second row	Contains the standard user form buttons listed in the following table. You can control the second row by setting `noDefaultButtons` option to true and implementing your own buttons.

This second row of button can vary as follows:

Table 2-19 Second Row of Buttons

Wizard page	Default buttons
first page	Next, Cancel
intermediate pages	Prev, Next, Cancel
last page	Prev, Ok, Cancel

Implementing a Wizard Form

Wizard form syntax closely resembles tabbed user form structure. To create a wizard form,

1. Assign the `WizardPanel` display class to the top-level container (rather than `TabbedPanel`).
2. Set the `noCancel` property to true.
3. Define one or more EditForm fields that contain the pages of the wizard.

The following example provides comments for guidance purposes:

```
<Form>
   <Display class="HtmlPage"/> ----- If not set, causes indentation and
color problems
   <Field name='MainTabs'> -- Name of the top container that wraps the
tab pages
      <Display class='TabPanel'/> -- Display class for the top
container: either TabPanel or WizardPanel
   <Field name='Identity'> -- Label of the Tab
      <Display class='EditForm'> -- Each "page" must be an Edit Form
         <Property name='helpKey' value='Identity and Password Fields'/>
      </Display>
   <Field name='waveset.accountId'>
      <Display class='Text'>
         <Property name='title' value='_FM_ACCOUNT_ID'/>
      </Display>
<Disable> <ref>waveset.id</ref> </Disable>

   </Field>
   </Field>

</Field>
```

Tips and Workarounds

- Validation errors appear on the last page that the user was on rather than the page on which the attribute appears. To work around this, include information in the validation message to assist the user in navigating back to the correct page.
- For complex wizards, give users some visual clue as to where they are in the process. Using labels or section heads at the top of every page that displays text similar to **Page 1**.
- Avoid using conditional navigation in wizard forms. If you must implement it, use Disable expressions for each of the immediate children of the `WizardPanel`. For example:

```
<Field name='Page2'>
   <Display class='EditForm'/>
   <Disable><neq><ref>showPage2</ref><s>true</s></neq></Disable>
...
</Field>
```

- Put fields or buttons on previous pages that cause their gating variables to be set. Disabled pages are automatically removed from transition logic.

Alternatives to the Default Create and Edit User Forms

When an administrator uses the default User form to edit a user, all resources that are owned by a user are fetched at the moment an administrator begins editing a user account. In environments where users have accounts on many resources, this potentially time-intensive operation can result in performance degradation. If you are deploying Identity Manager in this type of environment, consider using *scalable forms* as an alternative to the default Create and Edit User interfaces.

Overview: Scalable Forms

Scalable forms are customized forms that help improve the performance of Identity Manager's Edit and Create User interfaces in environments with many users and resources. This improved performance results from several features, including:

- incremental resource fetching
- selective browsing of a user's resources
- multiple resource editing

Identity Manager provides scalable versions of the default Edit and Create User forms.

Incremental Resource Fetching

Incremental resource fetching describes one method used by the Identity Manager server to directly query a resource for information over a network connection or by other means. Typically, when an administrator edits a user using the default user form, all resources that are owned by a user are fetched at the moment an administrator begins editing a user account. In contrast, the intent behind the design of scalable forms is to limit fetching by fetching only those resources that the administrator wants to view or modify.

Selective Browsing

Selective browsing, another feature incorporated into scalable forms, permits an administrator to incrementally view resources based on their owning role, on their resource type, or from a list of resources.

Multiple Resource Editing

Multiple resource editing allows an administrator to select subsets of resources for editing resource attributes. An administrator can select subsets based on roles, resource types, or from a list of resources.

When to Use Scalable Forms

Consider using scalable forms when

- **Administrators are manually editing users who have many resource accounts**. Implementing a scalable form under these circumstances allows administrators to selectively edit specific resource accounts without incurring the overhead of fetching the user's data for all resource accounts. This mechanism is particularly useful when a certain type of resource responds much slower than the other resource types associated with a user.

- Custom provisioning processes, such as ActiveSync, target only specific resources for updates

NOTE Do not use scalable forms when form logic includes attributes that reference other resources. In this configuration, these cross-reference attributes will either not be populated with the latest data, or these resources should be fetched together.

Do not use scalable forms when form logic includes attributes that reference other resources. In this configuration, these cross-reference attributes will either not be populated with the latest data, or these resources should be fetched together.

In addition, the scalable version of the Create User form provides limited benefit over the standard default version because a new user has no resources to begin with.

Available Scalable Forms

Identity Manager ships the following two scalable user forms, which are described below:

- Dynamic Tabbed User form, which provides an alternative to the default Tabbed User form
- Resource Table User form, which provides an alternative to the default Tabbed User form.

Dynamic Tabbed User Form

Provides an alternative to the default Tabbed User form, which fetches all resources as soon as an administrator begins editing. In contrast, Dynamic Tabbed User form features incremental fetching and editing of multiple resources based on resource type.

NOTE For detailed implementation information, see the comments associated with each user form in `WSHOME/samples/form_name.xml`.

Importing and Mapping the Form

Three forms are involved in the substitution of Dynamic Tabbed User form for the default Tabbed User form.

Table 2-20 Forms associated with Dynamic Tabbed User Forms

Form	Description
Dynamic Tabbed User Forms	Contains the features of the default Tabbed User Form but dynamically creates one tab per resource type.
Dynamic User Forms	Contains fields for creating resource type tabs on the user form.
Dynamic Forms Rule Library	Contains the rule library for dynamically printing out attributes for resources that have no specified user form.
Dynamic Resource Forms	Contains all forms that are currently compatible with the Dynamic Tabbed User form. Users can customize this list.

Installing Dynamic Tabbed User form involves two steps: importing the form, and changing the form mapping.

Step 1: Import the Form

1. From the Identity Manager menu bar, select **Configure > Import Exchange File**.
2. Enter the file name (`dynamicformsinit.xml`) or click **Browse** to locate the `dynamicformsinit.xml` file in the ./sample directory.
3. Click **Import**. Identity Manager responds with a message that indicates that the import was successful.

Step 2: Change Form Mapping

There are two methods of assigning a user form to an end user. Select a method to edit these form mapping depending upon how administrators in your environment will be using these forms. These methods include:

- **Assign Scalable User Form as the default User Form for all administrators**. If this is your choice, see Assign Scalable User Form as the Default User Form. Identity Manager administrators can assign one form that all administrators will use.
- **Separately assign the Scalable User Form to a particular administrator(s)**. If this is your choice, see Assign Scalable User Form per Administrator.

Assign Scalable User Form as the Default User Form

1. From the menu bar, select **Configure > Configure Form and Process Mappings**.
2. In the Form Mappings section, locate `userForm` under the Form Type column.
3. Specify Dynamic Tabbed User Form in the box provided under the Form Name Mapped To column.

Assign Scalable User Form per Administrator

1. From the menu bar, select **Accounts > Edit User**.
2. Select a user in one of these two ways:
   - Click on user name, then click **Edit**

     or

   - Right-click on the user name to display a pop-up menu, then select the **Edit** menu option
3. After the Default Edit User Form appears, click on the Security tab.
4. Find the User Form field and select Dynamic Tabbed User Form.
5. Click **Save** to save the settings.

Resource Table User Form

The Resource Table User Form contains most of the driving logic of the scalable version of the Edit User form. This form implements incremental fetching and multiple resource editing based on resource type.

For additional implementation information, see the comments in `WSHOME/samples/resourcetableformsinit.xml`.

Importing and Mapping the Form

Five forms are involved in the substitution of Resource Table User form for the default Tabbed User form.

Table 2-21 Forms Associated with Resource Table User Form

Form	Description
Resource Table User Form	Contains all globally available fields that are used for navigation, incremental fetching, and form layout. This main form drives all the other resource-related scalable forms.

Table 2-21 Forms Associated with Resource Table User Form

Form	Description
Resource Table User Form Library	Contains primary fields for the Resource Table User form. Includes bread crumb and navigation fields.
Resource Table Account Info Form	Contains Fields for account information section of Resource Table form.
Resource Table Rule Library	Contains the rule library for retrieving, counting, analyzing a user's resources. This is mostly used by the User Form Library and to build table data on roles and resources.
Resource Table Utility Library	Contains the rules used during the selection process on Resource Table Form, for example these rules retrieve resources per role or per type.

Installing Resource Table User form involves two steps: importing the form, and changing the form mapping.

Step 1: Import the Form

1. From the Identity Manager menu bar, select **Configure > Import Exchange File**.
2. Enter the file name or click **Browse** to locate `WSHOME/sample/resourcetableforms.xml`. Importing this file also imports:

Step 2: Change Form Mapping

1. From the menu bar, select **Configure > Configure Form and Process Mappings**.
2. In the Form Mappings section, locate `userForm` under the Form Type column.
3. Specify Resource Table User Form in the box provided under the Form Name Mapped To column.

Customizing Scalable Forms

After importing and mapping the scalable user form, you must customize it. To enable incremental fetching, you must identify:

- **resources accounts that are initially fetched**. Use the `TargetResources` form property to represent the resource names to be included on the fetch.

- **operations that are updated** when the final save operation occurs.

Both the Dynamic User Forms and the Resource Table User Forms use resource-specific forms for displaying a user's resource-specific attributes. The following user forms are located in the WSHOME/sample/forms directory and have been adapted for use by scalable forms.

- ./ACF2UserForm.xml
- ./ActivCardUserForm.xml
- ./ADUserForm.xml
- ./AIXUserForm.xml
- ./BlackberryUserForm.xml
- ./ClearTrustUserForm.xml
- ./HP-UXUserForm.xml
- ./NDSUserForm.xml
- ./OS400UserForm.xml
- ./PeopleSoftCompIntfcUserForm.xml
- ./RACFUserForm.xml
- ./SAPPortalUserForm.xml
- ./SolarisUserForm.xml
- ./SunISUserForm.xml
- ./TopSecretUserForm.xml

These forms are automatically imported along with both Dynamic Tabbed User Forms and Resource Table User forms.

If a deployment is using a resource type other than a type listed above, the scalable forms display a default User form that simply lists all attribute name and values specified in the schema mapping. To use an existing customized resource user form other than those listed above, you must make certain modifications in order to ensure compatibility with the scalable forms. The following procedure describes some of the steps necessary to ensure compatibility.

NOTE Refer to any one of the forms in this list as an example of this modification.

Customizing a Resource Form for Compatibility with Scalable User Forms

To add your own customized resource form for use with either the Dynamic Tabbed or Resource Table user forms, follow these general steps.

Step One: Modify Dynamic Resource Forms

Instructions for adding your own resource form are provided in the `dynamicformsinit.xml` file. Search within this file for the Dynamic Resource Form and follow the steps provide with the form.

NOTE The steps described within the form are presented in comments, and are not displayed in the form once it is imported.

Step Two: Modify Your Resource Form

If you are not using a form from the preceding list, you will need to modify your resource form so that it is compatible. Refer to any of the files listed above for examples. Instructions are listed on the top of each resource form.

Customizing Tabbed User Form: Moving Password Fields to the Attributes Area

To update two resources with different passwords simultaneously, you must generate a separate password field for each assigned resource. For example, you can have an AD password field on the AD resource Attribute area (on the Accounts page) that still conforms to password policies that can be set separately from other resources.

Default Password Policy Display

By default, Identity Manager displays password policy information on the **Accounts > Identity** tab, as shown below.

To move the password fields from their default position on the Identity area to the Attribute area, you must disable the default Identity Manager password synchronization mechanism by following these three steps:

1. Set the `manualPasswordSynchronization` checkout property
2. Add `Field` and `FieldLoop` components to the Tabbed User form
3. Add resource-specific password fields to the Tabbed User form

These steps are described in more detail below.

Step One: Set the manualPasswordSynchronization Checkout Property

Specify the `manualPasswordSynchronization` view check out option by adding the following property to the form:

```
<Form>

   <Properties>

     <Property name='manualPasswordSynchronization' value='true'/>

...

   </Properties>

...

</Form>
```

When `manualPasswordSynchronization` is set to true, Identity Manager displays per-resource password fields rather than using the password synchronizer.

Step Two: Turn Off Password Synchronization

You can disable password synchronization by turning off the selectAll flag under the Password view. To do this, add the following fields to the default forms:

```
 <Field name='password.selectAll'>
    <Comments>
     Force the selectAll flag off so we do not attempt synchronization.
     Necessary because it sometimes is set to true by the view handler.
    </Comments>
      <Expansion><s>false</s></Expansion>
 </Field>
    <FieldLoop for='res'>
      <expression>
        <remove>
           <ref>password.targets</ref>
           <s>Lighthouse</s>
        </remove>
      </expression>
    <Comments>
    Also must force the individual selection flags to false and display
    a password prompt for each resource since the view handler will
    default to true for new accounts.
    </Comments>
    <Field name='password.accounts[$(res)].selected'>
    <Expansion><s>false</s></Expansion>
    </Field>
 </FieldLoop>
```

Step Three: Add Resource-Specific Password Fields to Attributes Page

Write resource specific password fields for each resource as follows:

```
<Field name='accounts[resname].password'>
```

Turning Off Policy Checking

You can turn off policy checking in your user form by adding the following field to the form:

```
<Field name='viewOptions.CallViewValidators'>
  <Display class='Hidden'/>
    <Expansion>
        <s>false</s>
    </Expansion>
</Field>
```

This field overrides the value in the OP_CALL_VIEW_VALIDATORS field of `modify.jsp`.

Tracking User Password History

By default, Identity Manager does not track user password changes initiated by administrators. The following options allow administrators to change this default behavior. Choose the option that best suits your deployment.

Option 1: Adding a View Option to a Form

You can add a view option to the target form, as shown below. Note that this view option will override any system configuration setting. Specifically, if you set the view option to `true`, and the relevant system configuration attribute is `false`, Identity Manager follows the view option and ignores the system configuration setting.

If you are working with a target form that is not part of ActiveSync processing, set the `savePasswordHistory` attribute on the target form (typically User form) as shown below.

Code Example 2-38

```
<Field name='savePasswordHistory'>
   <Default>
      <Boolean>true</Boolean>
   </Default>
</Field>
```

To record password changes during Active Sync configuration, you must set the `savePasswordHistory` view option in a different way. You can modify the Synchronize User Password TaskDefinition by adding the following action to the SetPasswordView Activity.

Code Example 2-39

```
<Activity id='5' name='SetPasswordView'>
   <Action id='0'>
     <expression>
          <set name='PasswordView.resourceAccounts.password'>
             <ref>password</ref>
          </set>
     </expression>
   </Action>
<!-- Add action here -->
   <Action id='1'>
    <expression>
         <set name='PasswordView.savePasswordHistory'>
             <Boolean>true</Boolean>
        </set>
    </expression>
   </Action>
   <!-- end -->
   <Action id='2'>
     <expression>
       <dolist name='account'>
        <ref>PasswordView.resourceAccounts.currentResourceAccounts</ref>
```

Option 2: Changing a System Configuration Object Setting

Alternatively, you can edit the relevant System Configuration object setting. You can configure the `savePasswordHistory` option through the Login application.

1. In the System Configuration object, locate this path:

```
security.admin.changePassword.[login interface]
```

2. Switch the values for `savePasswordHistory` for the appropriate interfaces from `false` to `true` (see example below). By default, these values are `false`.

Code Example 2-40 Changing a System Configuration Object Setting

```
<Attribute name='security'>
  <Object>
    <Attribute name='admin'>
      <Object>
         <Attribute name='changePassword'>
            <Object>
               <Attribute name='Administrator Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
               <Attribute name='Command Line Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='IVR Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='SOAP Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='User Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
            </Object>
         </Attribute>
      </Object>
    </Attribute>
    <Attribute name='authn'>
       <Object> ..
```

Code Example 2-40 Changing a System Configuration Object Setting

```
                    </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='Command Line Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='IVR Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='SOAP Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
               <Attribute name='User Interface'>
                  <Object>
                     <Attribute name='savePasswordHistory'>
                        <Boolean>false</Boolean>
                     </Attribute>
                  </Object>
               </Attribute>
            </Object>
         </Attribute>
      </Object>
   </Attribute>
   <Attribute name='authn'>
      <Object> ..
```

To permit password history recordings through the SPML interface, you must set the following in the system configuration object:

`security.admin.changePassword.Command Line Interface`

Testing Your Customized Form

You can gather information about edited forms before implementing them in your runtime environment through the following ways:

- Check for errors with the `expression` statements within your form fields through the use of error logging.
- Use the Form Editor to validate the syntax of individual `expression` statements. The Form Editor displays syntax error messages from the parser in a pop-up window. For information on using the Form Editor, see the online help that is associated with the Form Editor.

Turning On and Off Error Logging

The Identity Manager error logging utility reports to standard output any problems with the syntax of form expressions. Once XPRESS tracing is turned on, you can limit log messages to XPRESS statements for a subset of the form with the `<block>` tag. To obtain more information about the processing of XPRESS statements, a configuration option in the `waveset.properties` file, `xpress.trace`, can be set to true. When this option is set to true, all evaluations of XPRESS statements will generate trace messages to the console. This can be used to debug statements that are evaluated inside a running application whose code cannot be changed to enable tracing through the XPRESS API.

You can turn on XPRESS tracing for all XPRESS fields through either the command line or the Identity Manager Administrator Interface. Turning on tracing this way affects all fields. To limit log messages to a subset of the form, use the `<block>` tag set to limit error tracing to only code within the `<block></block>` tags.

To turn on error logging from the command line for all expression evaluations in Identity Manager:

1. Open the `config/waveset.properties` file for editing.
2. Search on the line `xpress.trace=false`.
3. Change the `false` value to `true`.
4. Save the file.
5. Restart the application server.

Alternatively, you can use the Identity Manager Administrator Interface to turn on and off error logging.

1. Login into Identity Manager as Configurator.

2. Select **Debug** to open the Debug page.
3. From the Debug page, select **Reload Properties**.

To turn tracing off for XPRESS, set the `xpress.trace` value to `false`, and reload the `waveset.properties` file.

Sample Forms and Form Fields

This section provides examples of the default forms that ship with the product. It also describes how to incorporate sample forms in your environment.

NOTE The versions of forms that ship with your version of Identity Manager may differ slightly from these samples.

- Tabbed User Form
- End User Menu Form
- Anonymous User Menu Form

User Form Library

A form can be used as a container for a collection of fields rather than being used in its entirety. Identity Manager supports this use of forms with an object called User Form Library, which contains complex fields related to granular resource selection, such as those used for changing passwords.

The following list summarizes each library associated with User Library.

User Library	The primary user form library. It includes the other libraries in this table and also defines the **AuthenticationAnswers** field for the display and editing of authentication question answers.
Password Library	Fields related to password specification and synchronization.
Account Summary Library	Fields that display read-only summary information about the accounts associated with a user.
Account Link Library	Fields related to account linking, and multiple accounts per resource.

User Security Library	Fields related to user security including capabilities, form assignment, and approval forwarding.

User Form Library

This library contains only fields that are related to the Resource Accounts views which include:

- ChangeUserPassword
- Deprovision
- Disable
- Enable
- Password
- RenameUser
- ResetPassword
- ResetUserPassword
- ResourceAccounts

The library primarily consists of tables that display information about the resource accounts associated with an Identity Manager user and allows them to be selected for various operations.

Using the Sample Forms Library

You can include the sample forms shipped with Identity Manager in any of the forms you are customizing through the use of the `<FormRef>` element.

Follow these general steps to add sample forms to your environment:

Step 1: Import the Rule

Step 2: Import the Form

Step 3: Create a New Form from the Default Form (Add Include References and Add the Form Reference)

Step 1: Import the Rule

Use the Identity Manager Administrator Interface to load the sample rules. To do this:

1. From the Identity Manager menu bar, select **Configure > Import Exchange File**.
2. Enter the sample file name or click **Browse** to locate the file in the `idm\sample\rules` directory.

   Sample common rule file names are:

   - sample\rules\ListGroups.xml
   - sample\rules\NamingRules.xml
   - sample\rules\RegionalConstants.xml

Sample resource rule file names are:

- sample\rules\ADRules.xml
- sample\rules\NDSRules.xml
- sample\rules\NTRules.xml
- sample\rules\OS400UserFormRules.xml
- sample\rules\RACFUserFormRules.xml
- sample\rules\TopSecretUserFormRules.xml

3. Click **Import**. Identity Manager responds with a message indicating that the import was successful.

Step 2: Import the Form

Use the Identity Manager Administrator Interface to load the sample form. To do this:

1. From the Identity Manager menu bar, select **Configure > Import Exchange File**.
2. Enter the sample file name or click **Browse** to locate the file in the `idm\sample\forms` directory. Sample form file names are:

   - sample\forms\ACF2UserForm.xml
   - sample\forms\ AIXUserForm.xml
   - sample\forms\HP-UXUserForm.xml

- sample\forms\NDSUserForm.xml
- sample\forms\NTform.xml
- sample\forms\OS400UserForm.xml
- sample\forms\SecurIDUserForm.xml
- sample\forms\SolarisUserForm.xml
- sample\forms\TopSecretUserForm.xml
- sample\forms\vitalStatform.xml

3. Click **Import**. Identity Manager responds with a message indicating that the import was successful.

Step 3: Update the Tabbed User Form (Add Include References)

Add an include reference to the sample form from the Tabbed User Form or a main form you created. To do this:

1. Copy the Tabbed User Form and rename it (for example, <*CompanyName*>`tabbedUserForm`).
2. In your Web browser address line, type this URL, and then press **Enter**.

   http://*ApplicationServerHost:Port*/idm/debug
3. After you authenticate, Identity Manager displays the System Settings page.
4. Select the UserForm option from the Type list, and then click **List Objects**.
5. Click **Edit** next to the <*CompanyName*>`tabbedUserForm` (or the main form you created).
6. Change the includes area of the form to add each sample form, shown in the following example in bold text:

```
<Include>
  <ObjectRef type='UserForm' id='#ID#UserForm:UserformLibrary'
name='UserForm Library'/>
  <ObjectRef type='UserForm' name='UserFormName'/>
<Include>
```

Values for *UserFormName* can be:

- ACF2 User Form
- AIX User Form
- HP-UX User Form

- LDAP Active Sync User Form
- Netegrity Siteminder Admin Form
- Netegrity Siteminder LDAP User Form
- Netegrity Siteminder ExampleTable User Form
- NDS User Form
- NT User Form
- Open Networks User Form
- OS400 User Form
- Oracle ERP User Form
- RACF User Form
- RSA ClearTrust User Form
- SecurID User Form
- Skeleton Database Active Sync User Form
- Solaris User Form
- Tivoli Access Manager
- Top Secret User Form
- Global Attributes (vitalStatform.xml)

Continue with the next section before saving the form.

Step 4: Update the Tabbed User Form (Add the Form)

Add a FormRef for each sample form to add it to the main form.

1. Add the following line for each sample form in an appropriate location in the main form:

   ```
   <FormRef name='UserFormName'/>
   ```

2. Remove the following line:

```
<FormRef name='MissingFields'/>
```

3. Click **Save** to save form changes.

Compliance-Related Forms

Table 2-22 Compliance-Related Forms

Form Name	General Purpose
Access Approval List	Display the list of attestation workitems
Access Review Delete Confirmation	Confirm the deletion of an access review
Access Review Abort Confirmation	Confirm the termination of an access review
Access Review Dashboard	Show the list of all access reviews
Access Review Summary	Show the details of a specific access review
Access Scan Form	Display or edit an access scan
Access Scan List	Show the list of all access scans
Access Scan Delete Confirmation	Confirm the deletion of an access scan
UserEntitlementForm	Display the contents of a UserEntitlement
UserEntitlement Summary Form	
Violation Detail Form	Show the details of a compliance violation
Remediation List	Show a list of remediation work items
Audit Policy List Detailed	Show a list of audit policies
Audit Policy Delete Confirmation Form	Confirm the deletion of an audit policy
Conflict Violation Details Form	Show the SOD violation matrix
Compliance Violation Summary Form	

Using the FormUtil Methods

This section discusses high-level considerations and usage tips for this class of methods. The FormUtil methods are utilities used by forms when transforming a view. You can find specific information about each method in the FormUtil Javadoc.

For information on specific methods, see *<distribution>*`\REF\javadoc`, where *<distribution>* is your installation directory.

FormUtil Class Methods

The `FormUtil` class provides a collection of utility methods that are intended to be called from XPRESS expressions within form objects. The FormUtil methods are usually used within the `valueMap` property of `Select` and `MultiSelect` fields to constrain the list of possible values. Identity Manager provides additional methods to format string values such as dates and directory DNs.

Understanding Method Context

Any FormUtil method that needs to access the Identity Manager repository will need a context object.The Lighthouse context represents an authenticated session, which is subject to authorization checking to enforce visibility and action restrictions.

Fetching Context

Most FormUtil methods require that a LighthouseContext or Session object be passed as the first argument by referencing the view attribute `display.session`. Since forms are often used with a base context prefix, it is recommended that the `display.session` reference always be preceded with a colon (`:display.session`) to remove the base context prefix.

Invoking Methods

Use the following syntax to invoke the FormUtil methods from within a form:

```
<invoke class = 'com.waveset.ui.FormUtil'

   name = 'method_name'>

      <ref>:display.session</ref>

      <s>arg2</s>

</invoke>
```

where the `name` field identifies the name of the method.

Calling FormUtil Methods without Knowing the Context

You can use `select` without understanding which variable specifies the Lighthouse Context. This approach facilitates re-use of the method invocation.

```
<select>

   <ref>:display.session</ref>

   <ref>context</ref>

</select>
```

In a form, you would specify the context with `<ref>:display.session</ref>`. However, the same FormUtil call in a workflow would instead use `<ref>context</ref>`.

A third method for fetching context involves invoking a getLighthouseContext method using WF_CONTEXT object. Below we wrap all three techniques in a rule, which can be used later.

Code Example 2-41

```
<rule name='Get Context'>
<select>
   <ref>:display.session</ref>
   <ref>context</ref>
   <invoke name='getLighthouseContext'>
      <ref>WF_CONTEXT</ref>
   </invoke>
</select>
</rule>
```

Best Practice

You can create a rule with a name such as Get Context that contains a simple `<select>` statement. You can then call that rule from any form or any workflow during an invocation of the desired FormUtil method, as shown in the following example:

Code Example 2-42

```
<invoke name='getObject'>
 <!-- typically, something like :display.session would go here. But
instead, call the handy rule -->
<rule name='Get Context'/>
 <s>User</s
<s>SamUser</s>
</invoke>
```

That invocation could then be part of a greater utility rule that you can use in both forms and workflows.

Commonly Invoked Methods

The following table provides a brief introduction to the most commonly used FormUtil methods.

Method	Description
callResourceMethod	Invokes the specified method on the resource by passing it the specified arguments.
buildDn, buildDns	Takes a name (or names) and the base context to append to the name. This method returns a string of fully qualified distinguished (DN) names. For example, passing in group1 and dc=example,dc=com returns the string cn=group1, dc=example, dc=com.
checkStringQualityPolicy	Checks the value of a designated string against string policy.
controlsAtLeastOneOrganization	Determines whether a currently authenticated user controls any of the organizations specified on a list of one or more organization (ObjectGroup) names. The supported list of organizations include those returned by listing all objects of type ObjectGroup.
getObject	Retrieves an object from the repository (subject to authorization).

Method	Description
getObjectNames	Returns a list of the names of objects of a given type to which the session owner (or currently logged-in user) has access. Additional parameters can be specified in the options map to control the list of names returned. This method is the preferred way for returning a list of names of objects rather than attempting `session.getObjects()`. This method first goes to the ObjectCache, then to the repository, if necessary, for searches.
getOrganizationsDisplayNames	Returns a list of organization handles that the current administrator has access to. Forms that need select and multiselection lists of organizations should use this method.
getResources	Builds a list of the names of resources that match a particular resource attribute value (such as type=LDAP). If a current list is passed in, the lists are merged.
getResourceObjects	Returns a list of objects where each object contains a set of attributes including type, name, and ID (a DN, or fully qualified name) as well as any requested `searchAttrsToGet` value. The returned value is a List of GenericObjects. Each GenericObject can be accessed similar to how a Map is accessed. Invoking a `get` method on each object, which passes in the name of the attribute, returns the attribute value.
getRoles	Returns a list of role names that the current administrator has access to. If a current value or current list is supplied, the role name or names on the list are added to the role names returned.
geUnassignedApplications	Builds a list of application names suitable for a user's private applications. (A *private application* is an application that is directly assigned to a user.) This is the list of all accessible applications minus the names of the applications that are already assigned to the user through their role. The resulting list is convenient for use in forms for assigning private applications.
getSubordinates	Retrieves a list of the specified managerial subordinates of a user.
getUnassignedResources	Build a list of resource names suitable for the private resources of a user. (A *private resource* is a resource that is directly assigned to a user.) This is the list of all accessible resources minus the names of the resources that are already assigned to the user through their role. The resulting list is convenient for use in forms for assigning private resources.
getUsers	The first variant of this method returns all users. The second variant by default returns all users, but you can specify a map of options to further filter the list.

Method	Description
listResourceIObjects	Retrieves a list of resource objects of a specified type (for example, `group`). This method first attempts to get the list from the server's `resourceObjectListCache`. If found, this list is returned. If this list is not found, the method invokes the `listResourceObjects` method on each resource before merging, sorting, and removing duplicates on the resulting lists. Finally, it caches this new list in the server's `resourceObjectListCache` for any subsequent requests for the same resource object type from the same resource(s). This method runs as the currently authenticated administrator (for example, `subject`). Variants take a single resource ID or a `subject` string and an existing session. This method has multiple variants that differ on whether: The method returns a single resource versus a resource list. The cache should be cleared. The method is sending a session ID (implemented when the user has already been authenticated) or a subject string (`subjectString`). Typically, you will use `Session`.
testObject	Tests to see if a specified object exists, even if the subject is not authorized to view the object. When launching processes to create new users, use this method to prevent attempts to create duplicate objects by an administrator who cannot see the entire tree.
testUser	Tests to see if a specified user exists, even if the subject is not authorized to view the object. When launching processes to create new users, use this method to prevent attempts to create duplicate objects by an administrator who cannot see the entire tree.
hasCapability, hasCapabilities	Checks to see if the user has a specified capability or capabilities (String). This method checks for a capability that is assigned either directly or indirectly through AdminGroups and/or AdminRoles. Requires a `session` value.

Tips on FormUtil Usage

Some of the trickiest common implementation of the FormUtil methods involve retrieving objects, particularly using the following methods.

- `getObject`
- `getResourceObject`
- `getUnassigned*`

This section introduces basic hints for using these methods.

Using getObject to Fetch Objects from the Repository

The `getObject` method is the most commonly used method for retrieving an object from within the repository. When using this method, remember that you are fetching actual (Java) objects. To access attributes from that object, you must wrap the object in an invocation that calls the object's getter methods. Because each object uses particular get operations, refer to the individual object's Javadoc for more detail.

When working with the WSUser object, you can use the WSUser object's `toHashMap()` method. This method converts the object into a GenericObject, which is equivalent to a Java HashMap, as shown in the following example:

Code Example 2-43

```
<set name='wsUserObj'>
   <invoke name='getObject'>
<!-- typically, a value such as :display.session would go here.  But
instead, call the handy rule -->
       <rule name='Get Context'/>
       <s>User</s.
       <s>SamUser</s>
   </invoke>
</set>
<set name='wsGenericObj'>
   <invoke name='toHashMap'>
  <ref>wsUserObj</ref>
   </invoke>
</set>
```

To retrieve the `accountId` from the WSUser object, use the following

```
<invoke name='getAccountId'>

 <ref>wsUserObj</ref>

</invoke>
```

However, when you are working with a user, this method can become tedious. The same thing via the WSUser object now converted into a GenericObject:

```
<ref>wsGenericObj.waveset.accountId</ref>
```

Basically, GenericObjects, such as views, can be much easier to work with than the WSUser object. Consider checking out the view of the associated object when dealing directly with the object is cumbersome.

NOTE Some operations will result in the repository locking the underlying PersistentObject. Typically, methods that begin with the phrase "checkout" will lock the object, "checkin" will unlock it), and methods that being with "get" will not lock the object.

Using getResourceObject to Fetch Objects from a Resource

The `getResourceObject` operation returns the specified object from the specified resource as a GenericObject. See the *Resource Reference* for an explanation of which objects can be fetched and which attributes are supported in the list. This method results in a call to the corresponding resource adapter.

Using the getUnassigned* Methods

The `getUnassigned*` methods retrieve features that are not currently assigned to the provided user (through the lh context). These methods are handy when you must create a User form that offers the user to select, and thus request access to, a feature they currently do not have. For example:

Code Example 2-44

```
<Field name='waveset.resources'>
   <Display class='MultiSelect' action='true'>
     <Property name='title' value='_FM_PRIVATE_RESOURCES'/>
     <Property name='availableTitle' value='_FM_AVAILABLE_RESOURCES'/>
     <Property name='selectedTitle' value='_FM_SELECTED_RESOURCES'/>
     <Property name='allowedValues'>
       <invoke name='getUnassignedResources'
class='com.waveset.ui.FormUtil'>
           <ref>:display.session</ref>
           <map>
             <s>current</s>
             <ref>waveset.resources</ref>
           </map>
       </invoke>
    </Property>
   </Display>
</Field>
```

Using listResourceObject Method

There are ten versions of the `listResourceObject` method. Some versions require that you supply a single resource ID, or a list of resources, or a Boolean to clear the cache or other caching details. Other versions provide the ability to specify that the method to run as a different user.

When implementing this method within a form or rule, clarify in comments which version of this method you are using. For example,

```
Lists the Groups on the AD-Austin resource starting at the OurGroups OU.  It
will leverage the server cache should this list be found there.

Additional details in the Identity Manager formUtil javadocs under:

public static java.util.List listResourceObjects(java.lang.String
subjectString,

java.lang.String objectType,

java.lang.String resourceId,

java.util.Map options,

java.lang.String cacheList)
```

Tricky Scenarios Using FormUtil Methods

Because most FormUtil processing involves views, the most common view-related method used in forms are the checkoutView and checkinView methods.

A typical checkout operation would be:

Code Example 2-45

```
<Action id='-1' application='com.waveset.session.WorkflowServices'>
   <Argument name='op' value='checkoutView'/>
   <Argument name='type' value='User'/>
   <Argument name='id' value='mfairfield'/>
   <Variable name='view'/>
   <Return from='view' to='user'/>
</Action>
```

Using map of options with Checkout and Checkin Calls

Determining which options you can use as optional arguments for these check out and check in calls can be challenging. These optional arguments are defined as part of the UserViewConstants class. The Javadocs list options in this format:

`OP_TARGETS`

`OP_RAW`

`OP_SKIP_ROLE_ATTRS`

Instead of hard-coding these literal strings in your code when checking for options, we define constants that can be used throughout the code base to represent a string. While this is a good coding practice, you cannot reference a static field, such as OP_TARGET_RESOURCES, through XPRESS or workflow.

To identify valid strings that you can pass in the correct value, you can write a test rule that reveals the true string. For example, the following rule returns `TargetResources`.

Code Example 2-46

```
<block>
   <set name='wf_srv'>
      <new class='com.waveset.provision.WorkflowServices'/>
   </set>

   <script>
      var wfSvc = env.get( 'wf_srv' );
      var constant = wfSvc.OP_TARGETS;
      constant;
   </script>
</block>
```

Although handy for finding out a string, this rule does not lend itself to production deployment because it returns the same string for every call made to it.

One you've identified valid strings, you can update your checkout view call as follows. The following code checks out a view that only propagate changes to Identity Manager and AD.

Code Example 2-47

```
<Action id='-1' application='com.waveset.session.WorkflowServices'>
   <Argument name='op' value='checkoutView'/>
   <Argument name='type' value='User'/>
   <Argument name='id' value='mfairfield'/>
   <Argument name='options'>
      <map>
       <s>TargetResources</s>
       <list>
          <s>Lighthouse</s>
          <s>AD</s>
       </list>
     </map>
   </Argument>
<Variable name='view'/>
<Return from='view' to='user'/>
</Action>
```

Best Practices

From a performance perspective, best practice suggests limiting the size of the user view, whenever possible. A smaller view means less data is pulled from the resource and sent over the network. For instance, if a customer decides to implement a custom workflow for users to request access to a particular resource, that workflow should check out the user's view to allow a change to be submitted to it (pending the appropriate approval, of course). In this example, it is likely that the only information that must be available is the Identity Manager User portion of the view so that the `waveset.resources` list and the `accountInfo` object can be updated appropriately. In that situation, use the TargetResources option when checking out the User view to only checkout the Identity Manager user portion of the User view with an option map similar to the following:

Code Example 2-48

```
<map>
   <s>TargetResources</s>
   <list>
      <s>Lighthouse</s>
   </list>
</map>
```

Additional Options

The following options are used by a subset of the FormUtil methods:

- *scopingOrg*
- *conditions*
- *current*

scopingOrg

Use this option when two or more AdminRoles are assigned to a user. The value of this option should be the name of an organization. This value specifies that the returned names should consist only of names that are available to organizations that are controlled by an AdminRole. The AdminRole must control the scopingOrg organization and is assigned to the logged-in user.

This option is typically used to ensure that when a user is creating or editing another user, the member organization of the user being edited determines which names (for example, Resourcenames) are available for assignment.

Using the scopingOrg Parameter

Set this attribute under these conditions:

- The specified user is assigned more than one AdminRole
- You want to ensure that when the administrator is creating or editing a user, the member organization of the user being created or edited determines which object names of the requested type are available for assignment.

For example, under these circumstances:

- the administrator were assigned both the Engineering AdminRole and Marketing AdminRole
- the administrator is editing a user who is a member of the Engineering organization

the resources available for assigning to that user should be limited to the resources available to the organization(s) controlled by the Engineering AdminRole.

Implementing the scopingOrg Attribute

To implement the behavior described above, add the `scopingOrg` attribute to the `waveset.resources` field in the User form.

Reference the value of the current organization as follows:

Code Example 2-49

```
<Field name='waveset.resources'>
   <Display class='MultiSelect'>
      <Property name='title' value='_FM_PRIVATE_RESOURCES'/>
      <Property name='availableTitle'
          value='_FM_AVAILABLE_RESOURCES'/>
      <Property name='selectedTitle' value='_FM_SELECTED_RESOURCES'/>
      <Property name='allowedValues'>
         <invoke class='com.waveset.ui.FormUtil'
           name='getUnassignedResources'>
             <ref>:display.session</ref>
               <map>
                  <s>currentRoles</s>
                  <ref>waveset.roles</ref>
                  <s>currentResourceGroups</s>
                  <ref>waveset.applications</ref>
                  <s>current</s>
                  <ref>waveset.original.resources</ref>
                  <s>scopingOrg</s>
                  <ref>waveset.organization</ref>
               </map>
         </invoke>
      </Property>
   </Display>
</Field>
```

current

Specifies a list of names to be merged with those returned. For example, this is typically the list of selected names in a `MultiSelect` field to ensure that all selected names are in the `MultiSelect`'s list of available names.

conditions

This value contains a set of AttributeConditions that specify particular attributes, their expected values, and a comparison operator. AttribueConditions can be specified in three ways:

Table 2-23 Values of conditions Attribute

Value Format	Description
Map	As a map containing `<MapEntry>` elements, each `<MapEntry>` element contains the attribute name to be matched as the *key* and the value to be matched as the *value*. (The operator is assumed to be "equals".) If more than one attrname/value pair is specified, they will be logically and'ed together. Example <Map> <MapEntry key='memberObjectGroups' value='Top'/> </Map>
map	As a map with no `<MapEntry>` elements, the first entry is the name of a queryable attribute supported by this type of object. The second entry is the value an object of this type must have for the associated queryable attribute to be returned. (The operator is assumed to be "equals".) If more than one attrname/value pairs is specified, they will be logically and'ed together. Example <map> <s>memberObjectGroups</s> <ref>waveset.organizations</ref> </map>

list	As a list of `AttributeCondition` objects. If more than one `AttributeCondition` is specified, they will be logically and'ed together. You must use this form if you must specify an operator other than ‘equals’.
	Example
	`<list>`
	`<newclass= 'com.waveset.object.AttributeCondition'>`
	`<s>MemberObjectGroups</s>`
	`<s>equals</s>`
	`<ref>waveset.organization</ref>`
	`</new>`
	`</list>`

Using the conditions Attribute

You can specify a list of one or more object type-specific query attribute conditions to filter the list of names returned by certain FormUtil methods. (These methods include methods that take an `options` map as an argument.) You can specify these query attribute conditions as a query option whose key is `conditions` and whose value can be specified as either a map or list of `AttributeConditions`.

Examples: Using the condition Attribute to Filter Names

The following examples illustrate the use of the `conditions` attribute to apply additional filters to the list of names returned by a FormUtil method that takes an *options* map as an argument. This example uses `conditions` to specify that only resources that support container object groups of type LDAP should be returned.

Code Example 2-50 First Example of Using the conditions Attribute

```
<Field name='waveset.resources'>
   <Display class='MultiSelect' action='true'>
 ...
     <Property name='allowedValues'>
        <invoke class='com.waveset.ui.FormUtil'
         name='getUnassignedResources'>
           <ref>:display.session</ref>
               <map>
               <s>currentRoles</s>
               <ref>waveset.roles</ref>
               <s>currentResourceGroups</s>
               <ref>waveset.applications</ref>
               <s>current</s>
               <ref>waveset.original.resources</ref>
               <s>conditions</s>
                 <map>
               <s>supportsContainerObjectTypes</s>
               <s>true</s>
               <s>type</s>
               <s>LDAP</s>
                 </map>
               </map>
       </invoke>
     </Property>
   </Display>
</Field>
```

This second example requests resources that support container objects where the resource has a name that starts with *ldap*. Note that the value for the queryable attributes are compared case-sensitive.

Code Example 2-51 Second Example of Using the conditions Attribute

```
<Field name='orgResource'>
   <Display class='Select' action='true'>
       ...
      <Property name='allowedValues'>
        <invoke class='com.waveset.ui.FormUtil'
           name='getResourcesSupportingContainerObjectTypes'>
           <ref>:display.session</ref>
             <map>
                <s>conditions</s>
                <list>
                   <new class='com.waveset.object.AttributeCondition'>
                      <s>name</s>
                      <s>starts with</s>
                      <s>ldap</s>
                   </new>
                </list>
             </map>
        </invoke>
      </Property>
   </Display>
</Field>
```

Code Example 2-52 Third Example of Using the conditions Attribute

```
<Field name='accounts[Lighthouse].capabilities'>
   <Display class='MultiSelect'>
         ...
     <Property name='allowedValues'>
        <invoke class='com.waveset.ui.FormUtil'
           name='getUnassignedCapabilities'>
           <ref>:display.session</ref>
           <ref>waveset.original.capabilities</ref>
             <map>
             <s>conditions</s>
               <list>
                  <new class='com.waveset.object.AttributeCondition'>
                    <s>name</s>
                    <s>starts with</s>
                    <s>bulk</s>
                  </new>
               </list>
             </map>
        </invoke>
     </Property>
   </Display>
</Field>
```

Supported Queryable Attribute Names

The list of supported queryable attribute names per object type are categorized as follows:

Other queryable attribute names are defined in the Identity Manager Schema Configuration configuration object (for example, `firstname` and `lastname`).

Supported Operators

Identity Manager performs all comparisons of queryable attributes with case-sensitive semantics. Furthermore, Identity Manager carries out comparisons using String comparison semantics., so 1000<999 (because String comparisons compare character by character, and 9 is greater than 1.

- `equals` or `'is equal'`
- `notEquals` or `is 'not equal'`
- `greaterThan` or `'greater than'`
- `greaterThanOrEqualTo` or `'not less than'`

- `lessThan` or ‘`less than`’
- `lessThanOrEqualTo` or ‘`not greater than`’
- `startsWith` or ‘`starts with`’
- `endsWith` or ‘`ends with`’
- `contains` or ‘`contains`'
- `isPresent` or `exists`
- ‘`notPresent`'
- `isOneOf` or `is one of`'
- `containsAll`

Chapter 3

Identity Manager Views

This chapter introduces Sun™ Identity Manager views, which are data structures used in Identity Manager. It provides background for views, including an overview of how to implement views with Identity Manager workflows and forms as well as reference information.

You can use the Identity Manager IDE to learn more about Identity Manager views and other generic objects. Instructions for installing and configuring the Identity Manager IDE are provided on https://identitymanageride.dev.java.net.

Topics in this Chapter

This chapter is organized into the following sections:

- Understanding IDM Views
- Understanding the User View
- Common Views
- View Options
- Deferred Attributes
- Extending Views

Understanding Identity Manager Views

An Identity Manager *view* is a collection of attributes that is assembled from one or more objects managed by Identity Manager. Views are transient, dynamic, and not stored in the repository. The data in a view can change if the view is refreshed to reflect a new role or resource assignment.

If you are using Identity Manager, you will encounter views primarily in forms and workflows. An Identity Manager *form* is an object that describes how to display view attributes in a browser for editing. The form can also contain the rules by which hidden attributes are calculated from the displayed attributes. A *workflow process* is a logical, repeatable, series of activities during which documents, information, or tasks are passed from one participant to another for action, according to a set of procedural rules.

When working with views, it helps to first understand:

- general view concepts
- how views are used in Identity Manager
- frequently customized views

What Is a View?

The most important view is the *user view*, which contains the user attributes that are stored in Identity Manager and attributes that are read from accounts managed by Identity Manager. Some attributes in the user view are visible in the forms that are presented by the Identity Manager User and Administrator Interfaces. Other attributes are hidden or read-only. Hidden attributes are typically used by rules that derive other visible attributes or calculate field values.

For example, when creating a user (represented as a user view), an administrator enters a first and last name in the appropriate form fields on the Create User page. When the administrator saves the form, the system can calculate the user's full name in a hidden field by concatenating the first and last name. This full name can then be saved to one or more resources, including Identity Manager. Once approved (where approval is required), the system converts the user view back into one or more objects in the Identity Manager repository and sends the view to the resources assigned to the user to create or update the user's resource accounts.

View Attributes

A view is a collection of name/value pairs that are assembled from one or more objects stored in the repository, or read from resources. The value of a view attribute can be atomic such as a string, a collection such as a list, or reference to another object.

Any Boolean attribute can be omitted from a view. If omitted, the attribute is considered logically false.

What is a View Handler?

View handlers are Java classes that contain the logic necessary to create a view and perform actions specified by setting attributes of the view. View handlers also can include information for the convenience of interactive forms. When a view is checked in, the view handler reads the view attributes and converts them into operations on repository objects. The view handler will often launch a workflow to perform more complex tasks such as approvals or provisioning. Most view handlers that operate on users prevent you from checking in the view if there is already a workflow in progress for that user.

Views and Forms

Identity Manager forms contain rules for transforming data in views and describe how the view attributes are to be displayed and edited in a browser. The Identity Manager user interface processes the view and form to generate an HTML form. When the user submits the HTML form, Identity Manager merges the submitted values into the view, then asks the view handler to refresh the view. The view can be refreshed several times during an interactive editing session, and different HTML fields can be generated based on logic in the form. When the user is finished interacting, the view is checked in which typically results in the view being passed as input to a workflow process.

Views and Workflow

Checking in a view often results in a new workflow process being launched to complete the modifications specified in the view. The workflow can perform time-intensive tasks in the background, launch approval processes, query resources, or take whatever action is appropriate. During approvals, the administrator is able to examine the contents of the view and make changes if desired. After approvals, the view attributes are converted into modifications of one or more repository objects. For views related to users, *provisioning* may occur to propagate the changes to selected resource accounts.

Account Types and User-Oriented Views

When you assign an account type to a user, Identity Manager makes available the account type as well as the `accountId`. When working with the user-oriented views, including the User, Enable, Disable, and Deprovision views, follow these addressing guidelines:

- Use a value of null to indicate an account of the default type. Reference an accounts of the default type by resource name for example, accounts[corp-ad]
- Use a type-qualified name instead of the resource name to reference an account of a specific type. The type-qualified resource name takes this form:

  `<resource name>|<type of account>`

  To reference the account data for the account of type `Admin` on the resource corp-ad, reference `accounts[corp-ad|Admin]`.

Common Views

The following views are frequently used with both customized forms and workflows

`User`	Used to manipulate Identity Manager users and provision resource accounts.
AccountCorrelation	Used to search for users correlating to a specified account (or account attributes).
AdminRole	Used when assigning an Admin role to a user.
Enable	Used to present and select the list of resource accounts to be disabled.
Deprovision	Used to present and select a list of resources to be deprovisioned.
Disable	Used to present and select the list of resource accounts to be enabled.
ChangeUserAnswers	Used to change a user's authentication answers.
ChangeUserCapabilities	Used to change an Identity Manager user's capabilities.
List	Used to generate a list of work items and processes in the Identity Manager User Interface.
Org	Used to specify the type of organization created and options for processing it.

Password	Used to change an Identity Manager user's password, and optionally propagate the password to resource accounts.
Process	Used to launch tasks such as workflows or reports.
Reconcile	Used to request or cancel reconciliation operations.
ReconcileStatus	Used to obtain the status of the last requested reconciliation operation.
RenameUser	Used to rename the Identity Manager and resource account identities.
Reprovision	Used to present and select the list of resources to be reprovisioned.
ResetUserPassword	Used by administrators to reset a password to a randomly generated password and optionally propagate the new password to resource accounts.
Resource	Used to manipulate resources.
`ResourceObject`	A family of views used to manipulate arbitrary objects supported by a resource, for example groups and mailing lists.
Role	Used to specify the types of Identity Manager roles created.
TaskSchedule	Used to create and modify TaskSchedule objects.
Unlock	Used to unlock accounts for those resources that support native account locking.
WorkItem	Used when writing a workflow approval form.
WorkItemList	Used to view information about collections of work items in the repository and to perform operations on multiple work items at a time.

Understanding the User View

The *User view* is the collection of attributes that contain information about an Identity Manager user, including:

- Attributes stored in the Identity Manager repository
- Attributes fetched from resource accounts
- Information derived from other sources such as resources, roles, and organizations

The user view is most often used with forms that are designed for the pages that create or edit users. These pages launch workflow processes that store a changed user view until it is necessary to push the updated view information back out to Identity Manager and associated resources. While the user view is stored in a workflow process, the workflow process can manipulate attribute values through workflow actions. Workflow can also expose attribute values for user input through manual actions and approval forms.

How the User View Is Integrated with Forms

The user view is often used in conjunction with a form. Forms contain rules that control how data is presented through HTML fields and is processed after the HTML page rendering the form is submitted. A system component called the *form generator* combines a form definition and a view to produce HTML that a browser then displays.

View attribute values are displayed by assigning them to an *HTML component* in the form. (See Chapter 6, "HTML Display Components," for more information on how view attributes can be displayed.)

Views are implemented as instances of the `GenericObject` class. This class provides a mechanism for the representation of name/value pairs and utilities for traversing complex hierarchies of objects through *path expressions.* A path expression is a string that is interpreted at runtime to traverse an object hierarchy and retrieve or assign the value of an attribute.

You must understand how to write path expressions to assign valid form field names. For more information on using path expressions, refer to the section titled *Path Expressions*.

How the User View Is Integrated with Workflow

Workflow processes that contain a user view typically store it in a workflow variable named `user`. You can reference a view in the workflow expressions by prefixing `user` to a user view path (for example, `user.waveset.accountId`). The string `waveset` identifies the attribute named `accountId` as belonging to another object named `waveset`, which itself belongs to the user view object.

Approval forms are written for a view known as the *WorkItem view*. The Work Item view by default contains all the workflow variables under an attribute named `variables`. If the approval form is written for a workflow that contains a user view, the prefix `variables.user.` is used to reference attributes in the user view (for example, `variables.user.waveset.roles`). See *WorkItem View* later in this chapter for more information.

Generic Object Class

At a high level, objects are simply named collections of attributes, which are name/value pairs. The value of an attribute can be an atomic value such as a string, a collection such as a list, or a reference to another object. You can represent almost any object abstractly with the `Map`, `List`, and `String` Java classes.

Within the Identity Manager system, the `GenericObject` class provides a simple memory model for the representation of arbitrary objects and collections. It includes features for easily navigating object hierarchies to access or modify attribute values.

The `GenericObject` class implements the `java.util.Map` interface and internally uses a `java.util.HashMap` to manage a collection of name/value pairs. The entries in this map are called *attributes*. The value of an attribute can be any Java object that is able to serialize itself as XML. The most common attribute values found in a GenericObject:

The following are instances of the following classes:

- `String`
- `Integer`
- `Boolean`
- `EncryptedData`
- `List`
- `Date`
- `GenericObject`
- `X509cert`

You can construct complex hierarchies of objects by assigning `Lists` or `GenericObjects` as attribute values. Once you have assigned attribute values, you traverse this hierarchy to access the values of an attribute.

Path Expressions

A *path expression* is a string that is interpreted at runtime by the `GenericObject` class to traverse an object hierarchy and retrieve or assign the value of an attribute. Identity Manager uses a system of dots and brackets to represent objects and attributes in the hierarchy.

You use path expressions as the value of the `name` attribute in form fields when customizing a form (for example, `<Field name='user.waveset.roles'/>`).

Traversing Objects

The following simple example illustrates a `GenericObject` with two attributes:

- `name` (String)
- `address` (GenericObject) The address object, in turn, has an attribute named `street`, which is a string.

To create a path expression to the `street` attribute of the address object, use `address.street`.

Path expressions use the dot character (.) to indicate traversal from one object to another. This is similar to the way dot is used in Java or the '->' operator is used in C. Paths can be long, as illustrated by this example:

```
user.role.approver.department.name
```

Traversing Lists

You can also use path expressions to traverse values that are lists. Consider an object that has an attribute `children` whose value is a `java.util.List`. Each object in the list is itself a `GenericObject` with a `name` attribute and an `age` attribute. Write the path to the name of the first child as:

```
children[#0].name
```

Path expressions use square brackets to indicate the indexing of a list. The token between brackets is the *index expression*. In the simplest case, this is a positive integer that is used to index the list by element position.

Typically, the position of an object in a list is arbitrary. Index expressions can also specify simple search criteria to identify one object in the list. Objects in a list typically have a `name` attribute, which serves to uniquely identify this object among its peers. Path expressions support an implicit reference to an object's `name` attribute within the index expression.

For example

```
children[hannah].age
```

The preceding path expression obtains the list of objects stored under the `children` attribute. This list is searched until an object with a `name` attribute equal to `hannah` is found. If a matching object is found, Identity Manager returns the value of the `age` attribute.

Example: Using the = Operator

```
<ref>accountInfo.accounts[type=vms].name</ref>
```

`accountInfo.accounts[type=vms].name` returns a list of names for VMS resources. It returns a list of only one element if only exists.

Using the == Operator

`children[hannah].age` is equivalent to `children[name==hannah].age`. If you search using `type=LDAP` for example, you would get a list of names of LDAP resources. However, if you use the == operator, the result is a single object. For example, `children[parent=hannah].occupation` returns a list of occupations for all of hannah's children, but `children[parent==hannah].occupation` returns a single occupation (not in a list) for whichever child was found first.

Example

```
<index i='0'>

<   ref>accountInfo.accounts[type=vms].name</ref>

</index>
```

is equivalent to

```
<ref>accountInfo.accounts[type==vms].name</ref>
```

If more than one account with type `vms` exists, then either example will return the first account found with no particular guaranteed ordering.

Calculating Lists

You can also write path expressions that calculate `List` values that are not stored in the object. For example:

```
accounts[*].name
```

When an asterisk is found as an index expression, it implies an iteration over each element of the list. The result of the expression is a list that contains the results of applying the remaining path expression to each element of the list. In the previous example, the result would be a list of `String` objects. The strings would be taken from the `name` attribute of each object in the `accounts` list.

Path expressions with * (asterisk) are used with the `FieldLoop` construct in forms to replicate a collection of fields.

Account Types and User-Oriented Views

When you assign an account type to a user, Identity Manager makes available the account type as well as the `accountId`. When working with the user-oriented views, including the User, Enable, Disable, and Deprovision views, follow these addressing guidelines:

- Use a value of null to indicate an account of the default type. Reference an accounts of the default type by resource name for example, accounts[corp-ad]
- Use a type-qualified name instead of the resource name to reference an account of a specific type. The type-qualified resource name takes this form:

  `<resource name>|<type of account>`

  To reference the account data for the account of type `Admin` on the resource corp-ad, reference `accounts[corp-ad|Admin]`.

User View Attributes

Whenever you create or modify a user account from a web browser, you are indirectly working with the user view. From the perspective of altering user account information, it is the most significant view in the Identity Manager system.

Workflow processes also interact with the user view. When a request is passed to a workflow process, the attributes are sent to the process as a view. When a manual process is requested during a workflow process, the attributes in the user view can be displayed and modified further.

Introduction

Like all views, the user view is implemented as a `GenericObject` that contains a set of attributes. The values of the attributes in the root object are themselves `GenericObjects`. Attributes can be nested.

The user view contains the attributes described in the following table, which are further defined in subsequent sections.

Table 3-1 Top-Level Attributes User View

Attribute	Description
waveset	Contains information stored in the Identity Manager repository (the WSUser object). This is sometimes referred to as the *basic view*.
accounts	Contains the values of all resource account attributes fetched from resources. These are typically the values that are edited with forms.
accountInfo	Contains read-only information about the resources and accounts associated with the user.
display	Contains the read-only runtime state for the interface. It is used only during interactive editing of the user. display.session describes login and access information. display.subject identifies the account under which the user is logged in. display.eventType indicates whether the user view is servicing a create or an update operation.
global	Contains attributes that are synchronized across all resource accounts.
password	Contains attribute values that are specific to the user's password, password expiration, and target systems.

When you design a form, the field names are typically paths into the user view objects waveset. global, and account attributes (for example, global.firstname).

Selecting the Appropriate Variable Namespaces

The user view provides several namespaces for deriving account-related information. The following table summarizes these variable namespaces.

Table 3-2 Account-Related User View Attributes

Account-Related Namespace	Description
waveset.accounts	Used internally for difference detection during check-in operations. It contains the starting values for all account attributes. Do not modify this value.
accountInfo.accounts	Derived read-only information about the accounts that are linked to the user and their associated resources. Use this attribute in forms, but do not modify.
accounts	Stores the read/write copies of the account attributes. Updatable fields should point to this namespace.

Table 3-2 Account-Related User View Attributes

Account-Related Namespace	Description
`global`	Stores copies of global attributes. Values in this area appear only if the form defines global fields, or if you are using the special MissingFields reference. (The form determines how global attributes are processed.) If you set a global attribute in a workflow, you must also define a global field in the form. Simply depositing a global value in the view is insufficient.

Referencing Attributes

Within a form, you can reference attributes in two ways:

- Use the name attribute of a `Field` element by adding the complete attribute pathname as follows:

  ```
  <Field name='waveset.accountId'>
  ```

For more information on setting the `Field` name element in a form field, see the chapter titled *Identity Manager Forms*.

- Reference an attribute from within another field:

```
<Expansion>
   <concat>
       <ref>global.firstname</ref><s> </s>
      <ref>global.lastname</ref>
   </concat>
</Expansion>
```

Within workflow, you can reference `Field` attributes as process variables (that is, variables that are visible to the workflow engine) or in XPRESS statements for actions and transitions. When referencing these attributes in workflow, you must prefix the path with the name of the workflow variable where the view is stored (for example, `user.waveset.accountId`).

Attributes with Transient Values

You can define fields that store values at the top-level of the user view, but these values are transient. Although they exist throughout the life of the in-memory user view (typically the life of the process), the values of these fields are not stored in the Identity Manager repository or propagated to a resource account.

For example, a phone number value is the result of concatenating the values of three form fields. In the following example, `p1` refers to the area code, `p2` and `p3` refer to the rest of the phone number. These are then combined by a field named `global.workPhone`. Because the combined phone number is the only value you want propagated to the resources, only that field is prepended with `global`.

In general, use the top-level field syntax if you are:

- not pushing a field value out to Identity Manager or any other resource
- the field is being used only in email notifications or for calculating other fields.

Any field that is to be passed to the next level must have one of the path prefixes defined in the preceding table, User View Attributes.

```
Field name='p1' required='true'>
   <Display class='Text'>
      <Property name='title' value='Work Phone Number'/>
      <Property name='size' value='3'/>
      <Property name='maxLength' value='3'/>
   </Display>
</Field>
<Field name='p2' display='true' required='true'>
   <Display class='Text'>
      <Property name='rowHold' value='true'/>
      <Property name='noNewRow' value='true'/>
      <Property name='size' value='3'/>
      <Property name='maxLength' value='3'/>
   </Display>
</Field>
<Field name='p3' display='true' required='true'>
   <Display class='Text'>
      <Property name='rowHold' value='true'/>
      <Property name='noNewRow' value='true'/>
      <Property name='size' value='4'/>
      <Property name='maxLength' value='4'/>
   </Display>
</Field>
<Field name='global.workPhone' required='true' hidden='true'>
   <Expansion>
      <concat>
         <ref>p1</ref>
         <s>-</s>
         <ref>p2</ref>
         <s>-</s>
         <ref>p3</ref>
      </concat>
   </Expansion>
</Field>
```

waveset Attribute

The `waveset` attribute set contains the information that is stored in a `WSUser` object in the Identity Manager repository. Some attributes nested within this attribute set are not intended for direct manipulation in the form but are provided so that Identity Manager can fully represent all information in the `WSUser` object in the view.

Most Used Attributes

Not all attributes are necessary when creating a new user. The following list contains the `waveset` attributes that are most often visible during creation or editing. Some attributes are read-only, but their values are used when calculating the values of other attributes. All `waveset` attributes are described in the sections that follow this table.

Table 3-3 Most Used Attributes of the waveset Attribute (User View

Attribute	Editable?	Data type
`waveset.accountId`	Read/Write	String
`waveset.applications`	Read/Write	String
`waveset.correlationKey`	Read/Write	String
`waveset.creator`	Read only	String
`waveset.createDate`	Read only	String
`waveset.disabled`	Read/Write	String
`waveset.email`	Read/Write	String
`waveset.exclusions`	Read/Write	List
`waveset.id`	Read	String
`waveset.lastModDate`	Read	String
`waveset.lastModifier`	Read	String
`waveset.locked`	Read	String
`waveset.lockExpiry`	Read/Write	String
`waveset.organization`	Read/Write	String
`waveset.questions`	Read/Write	List
`waveset.resources`	Read/Write	List
`waveset.resourceAssignments`	Read/Write	List
`waveset.roleInfos`	Read/Write	List
`waveset.roles`	Read/Write	String
`waveset.serverId`	Read/Write	String

waveset.accountId

Specifies the visible name of the Identity Manager user object. It must be set during user creation. Once the user has been created, modifications to this attribute will trigger the renaming of the Identity Manager account.

For information on renaming a user, see *Identity Manager Administration*.

waveset.applications

Contains a list of the names of each application (also called *resource group* in the Identity Manager User Interface) assigned directly to the user. This does not include applications that are assigned to a user through a role.

waveset.attributes

Collection of arbitrary attributes that is stored with the `WSUser` in the Identity Manager repository. The value of the `waveset.attributes` attribute is either null or another object. The names of the attributes in this object are defined by a system configuration object named *Extended User Attributes*. Common examples of extended attributes are `firstname`, `lastname`, and `fullname`. You can reference these attributes in the following ways:

```
waveset.attributes.fullname
```

or

```
accounts[Lighthouse].fullname
```

You typically do not modify the contents of the `waveset.attributes` attribute. Instead, modify the values of the `accounts[Lighthouse]` attributes. When the attribute is stored, values in `accounts[Lighthouse]` are copied into `waveset.attributes` before storage. `waveset.attributes` is used to record the original values of the attributes. The system compares the values here to the ones in `accounts[Lighthouse]` to generate an update summary report. See the section on the `account[Lighthouse]` attribute for an example of how to extend the extended user attributes.

waveset.correlationKey

Contains the correlation value used to identify a user during reconciliation and discovery of users. You can directly edit it, although it is generally not exposed.

waveset.creator

Contains the name of the administrator that created this user.

This attribute is read-only.

waveset.createDate

Contains the date on which this account was created. Dates are rendered in the following format: `MM/dd/yy HH:mm:ss z`

Example

```
05/21/02 14:34:30 CST
```

This attribute is set once only and is read-only.

waveset.disabled

Contains the disabled status of the Identity Manager user. It is set to a value that is logically true if the account is disabled. In the memory model, it is either a Boolean object or the string `true` or `false`. When accessed through forms, you can assume it is a string.

You can modify this attribute to enable or disable the Identity Manager user, although it is more common to use the `global.disable`. (Prepending `global.` to a variable name ensures that the system applies the value of that variable to all resources that recognize the variable, including Identity Manager.)

Once this value becomes true, the user cannot log in to the Identity Manager user interface.

waveset.email

Specifies the email address stored for a user in the Identity Manager repository. Typically, it is the same email address that is propagated to the resource accounts.

Modifications to this attribute apply to the Identity Manager repository only. If you want to synchronize email values across resources, you must use the `global.email` attribute.

You can modify this attribute.

waveset.exclusions

List the names of the resource that will be excluded from provisioning, even if the resource is assigned to the user through a role, resource group, or directly.

waveset.id

Identifies the repository ID of the Identity Manager user object. Once the user has been created in Identity Manager, this value is non-null. You can test this value to see if the user is being created or edited. This attribute is tested with logic in the form. You can use it to customize the displayed fields depending on whether a new user is being created (`waveset.id` is null) or an existing user account is being edited (`waveset.id` is non-null).

Example

The following example shows an XPRESS statement that tests to see if `waveset.id` is null:

```
<isnull><ref>waveset.id</ref></isnull>
```

waveset.lastModDate

Contains the date at which the last modification was made. It represents the date by the number of milliseconds since midnight, January 1970 GMT. This attribute is updated each time a user account is modified.

This attribute is read-only.

waveset.lastModifier

Contains the name of the administrator or user that last modified this user account.

This attribute is read-only.

waveset.locked

Indicates whether the user is locked. A value of `true` indicates that the user is locked.

waveset.lockExpiry

Specifies when the user lock expires if the user's Lighthouse Account policy contains a non-zero value for the locked account expiry date. This attribute value is a human-readable date and time.

waveset.organization

Contains the name of the organization (or `ObjectGroup`) in which a user resides. An administrator can modify this attribute if he has sufficient privileges for the new organization.

Since changing an organization is a significant event, the original value of the organization is also stored in the `waveset.original` attribute, which can be used for later comparison.

waveset.original

Contains information about the original values of several important attributes in the `waveset` attribute. The system sets this value when the view is constructed and should never be modified. The system uses this information to construct summary reports and audit log records.

Not all of the original `waveset` attributes are saved here. The attributes currently defined for change tracking are:

- password
- role
- organization

To reference these attributes, prepend `waveset.original.` to the attribute name (for example, `waveset.original.role`).

password

Specifies the Identity Manager user password. When the view is first constructed, this attribute does not contain the decrypted user password. Instead, it contains a randomly generated string.

The `password` attribute set contains the attributes described in the following table.

Table 3-4 Attributes of the password Attribute (User View)

Attribute	Description
`password`	Identifies the password to be set
`confirmPassword`	Confirms the password to be set. The password should match the value of `password.password`
`targets`	Specifies a list of resources that can have their password changed
`selectAll`	Specifies a Boolean flag that signifies that the password should be pushed to all of the resources
`accounts[]`	Specifies a list of objects that contains information about each of the resources. This attribute contains two attributes, which are described below.
`accounts[<resource>]. selected`	Boolean. When set, indicates that the password should be changed on the resource.

Table 3-4 Attributes of the password Attribute (User View)

Attribute	Description
accounts[<resource>]. expire	Boolean. When set, indicates that the password will expire. This attribute is set to false if the user changes his own password. However, if an administrator changes another user's passwords, the flag is set to true. To prevent the password from being expired when administrators or proxy accounts other than the user change a password on an account, set accounts [<resource>].expire = <s>false</s> This setting ensures that the password is not expired Identity Manager does not force the user to change the password again

waveset.passwordExpiry

Contains the date on which the Identity Manager password will expire. When the view is initially constructed, the memory representation will be a `java.util.Date` object. As the view is processed with the form, the value can either be a `Date` object or a `String` object that contains a text representation of the date in the format `mm/dd/yy`.

waveset.passwordExpiryWarning

Contains the date on which warning messages will start being displayed whenever the user logs into the Identity Manager User Interface. This is typically a date prior to the `waveset.passwordExpiry` date in the same format (`mm/dd/yy`).

waveset.questions

Contains information about the authentication questions and answers assigned to this user. The value of the attribute is a `List` whose elements are `waveset.questions` attributes.

The `waveset.questions` attribute set contains the attributes described in the following table.

Table 3-5 waveset.questions Attributes (User View)

Attribute	Editable?	Description
answer	Read/Write	Encrypted answer to the question
id	Read	System-generated ID for the question
name	Read	Name used to identify this question
question	Read	Text of the authentication question

The name attribute is not stored. The system generates the name by transforming the id. This is necessary because question IDs are typically numbers, and numbers that are used to index an array in a path expression are considered absolute indexes rather than object names.

For example, the path waveset.questions[#1].question addresses the second element of the questions list (list indexes start from zero). However, since there may be only one question on the list whose ID is the number 1, the ID is not necessarily suitable as a list index. To reliably address the elements of the list, the system manufactures a name for each question that consists of the letter Q followed by the ID (in this example, Q1) . The path waveset.questions[Q1].question then always correctly addresses the question.

waveset.resources

Contains a list of the names of each resource that is assigned directly to the user. This list does not include resources that are assigned to a user through a role or through applications. You can add only unqualified resource names to this attribute. To find all resources that are assigned to a user, see the section on the accountInfo attribute.

waveset.resourceAssignments

Qualifies the assigned resource list. (This attribute parallels the existing attribute waveset.resources attribute.) All resources in this attribute appear as unqualified in waveset.resources. Even if a user is assigned only an account of non-default type, the resource will appear in waveset.resources.

You can add new assignments made to either `waveset.resource` or `waveset.resourceAssignments`, with the lists automatically resynchronizing when the view is refreshed. This adds an assignment for an account of default type. You can add both qualified and unqualified resource names to `waveset.resourceAssignments`. This adds an account of the specified type based on the qualifier.

waveset.roleInfos

Contains a list of objects that contain information about the roles assigned to this user.

Table 3-6

Attribute	Description
`approvalRequired`	(Boolean) Specifies whether approval is required for this optional role. If the value of `directlyAssigned` is false, and `assignmentType` is optional, this value determines if approval is required for this optional role or not
`assignedBy`	Identifies which role assigned to the user contains this role. If `directlyAssigned` is false, this value is the name of the directly assigned role or roles that resulted in this role being assigned
`assignmentType`	Specifies how the indirect role is assigned. If `directlyAssigned` is false, this value will be either `required`, `conditional`, or `optional`.
`directlyAssigned`	(Boolean) Specifies whether the role is directly assigned to the user.
`events`	Maps the name/date entries that define events to be processed for this role (for example, activation date and deactivation date). • `name` -- allowed values include:`activate` and `deactivate`. `activate` indicates when to provision this role. `deactivate` indicates when to deprovision this role. • `date` -- Date for associated event.
`info`	(Object) Contains role information that should not appear when determining user-role assignment changes. This object can have the following attributes: * `typeDisplayName` - role type display name / message key * `description` - user-provided description of the role
`name`	Specifies the role name

Table 3-6

Attribute	Description
type	Specifies the role type as defined in the Role Configuration object. Valid types include BusinessRole, ITRole, Application Role, Asset Role.
state	Specifies role assignment state. Valid values include assigned or pendingActivationDate. You can define additional custom states.

waveset.roles

Contains the names of the roles assigned to this user. An administrator can modify this attribute if he has sufficient privileges for the new roles.

Since changing a role is a significant event, the original value of the role attribute is also stored in the original view, which can be used for later comparison.

waveset.serverId

Use to set unique server names when your deployment includes multiple Identity Manager instances that point to one repository on a single physical server. See *Identity Manager Installation* for more information.

accounts Attribute

The accounts attribute contains a list of objects for each account linked to the Identity Manager user. Each account object contains the values of the account attributes retrieved from the resource.

The name of each account object is typically the name of the associated resource. If more than one account exists for a given resource, the object names take a suffix of the form |n where *n* is an integer. The first account on a resource has no suffix. The second account has the suffix |2. The third account on a resource has |3, etc.

For example, if you have a resource named Active Directory that defines an account attribute named Profile, the view path to this attribute would be:

accounts[Active Directory].Profile

If this view path were used in a form field, it would prevent the value of the global.Profile attribute from being propagated to the Active Directory account.

NOTE You may want to use account-specific attributes in forms rather than global attributes to prevent propagation of values to all resources

Overriding Resource Attributes

In addition to setting account attributes, you can also specify *resource attribute overrides* for each account. Resource attributes are attributes that are defined for the resource definition in Identity Manager, and consequently for the resource type. They are not attributes associated with an individual account. Examples of resource attributes include the host name of the server, or the base context in a directory.

You may want to create an account on a resource, but use a different value for one of the resource attributes. You could do this by duplicating the resource and changing the value, but excessive resource duplication can be confusing. Instead, resource attributes can be overridden on a per-account basis in the view.

Resource attribute overrides are stored in the attribute object under an attribute named `resourceAttributes`. If, for example, the resource defined an attribute named `host`, this could be specified in the view with the path:

```
accounts[Active Directory].resourceAttributes.host
```

NOTE Although overriding resource attributes is not recommended, sometimes you cannot avoid it. You might choose to overwrite a resource to avoid creating duplicate resources that point to the same physical resource but differ by one attribute. For example, in a customer environment that has multiple Active Directory servers, it may make more sense to override the resource attribute `host` in the form than to create a new resource. Contact your Identity Manager support representative for more information.

accounts[Lighthouse]

Sets the values of only the attributes stored in the Identity Manager repository. When a view is created, it contains a copy of the attributes in the `waveset.attributes` attribute set. When the view is saved, the system compares the contents of `accounts[Lighthouse]` with `waveset.attributes` to generate and update reports and audit log entries. Although this attribute is stored in the Identity Manager repository, changes to this attribute are not automatically propagated to resources.

The *Extended User Attributes* Configuration object defines the attributes that are allowed in this view. The system ignores any name found in this set of attributes that is not registered in the configuration object.

The following code is a sample of the *Extended User Attributes* Configuration object. This object maintains the list of attributes that are managed by the `waveset.attribute` set.

```
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE Configuration PUBLIC 'waveset.dtd' 'waveset.dtd'>
<!--  id="#ID#Configuration:UserExtendedAttributes" name="User Extended
Attributes"-->
 <Configuration id='#ID#Configuration:UserExtendedAttributes'
name='User Extended Attributes' creator='Configurator'
createDate='1019603369733' lastMod='2' counter='0'>
  <Extension>
    <List>
      <String>firstname</String>
      <String>lastname</String>
      <String>fullname</String>
<!—add string values here - - >
      <String>SSN</String>
    </List>
  </Extension>
  <MemberObjectGroups>
    <ObjectRef type='ObjectGroup' id='#ID#Top' name='Top'/>
  </MemberObjectGroups>
</Configuration>
```

This object can be modified to extend the list from the default `firstname`, `lastname`, and `fullname` attributes. In this case, an attribute called `SSN` has been added.

accounts[Lighthouse].delegates

Lists delegate objects, indexed by `workItemType`, where each object specifies delegate information for a specific type of work item

- If `delegatedApproversRule` is the value of `delegateApproversTo`, identifies the selected rule.
- If `manager` is the value of `delegateApproversTo`, this attribute has no value.

This attribute takes the attributes contained in the Attributes of accounts[Lighthouse].delegate* Attributes table.

accounts[Lighthouse].delegatesHistory

Lists delegate objects, indexed from 0 to *n*, where *n* is the current number of delegate history objects up to the delegate history depth. This attribute takes the attributes contained in the Attributes of accounts[Lighthouse].delegate* Attributes table.

accounts[Lighthouse].delegatesOrginal

Original list of delegate objects, indexed by `workItemType`, following a get operation or checkout view operation. This attribute takes the attributes contained in the following table.

Table 3-7 Attributes of accounts[Lighthouse].delegate* Attributes

Attributes of accounts[Lighthouse].delegate* Attributes	Description
`workItemType`	Identifies the type of `workItem` being delegated. See Delegate object model description for valid list of `workItem` types.
`workItemTypeObjects`	Lists the names of the specific roles, resources, or organizations on which the user is delegating future `workItem` approval requests. This attribute is valid when the value of `workItemType` is `roleApproval`, `resourceApproval`, or `organizationApproval`. If not specified, the value of this attribute default is to delegate future `workItem` requests on all roles, resources, or organizations on which this user is an approver.
`toType`	Type to delegate to. Valid values are: • manager • delegateWorkItemsRule • selectedUsers
`toUsers`	Lists the names of the users to delegate to (if `toType` is `selectedUsers`).
`toRule`	Specifies the name of the rule that will be evaluated to determine the set of users to delegate to (if `toType` is `delegateWorkItemsRule`).
`startDate`	Specifies the date when delegation will start.
`endDate`	Specifies the date when delegation will end.

accounts[Lighthouse].properties

The value of this attribute is an object whose attribute names correspond to the properties defined by the user. User properties allow arbitrary custom data to be stored with the user in the Identity Manager repository. You can then use properties in forms and workflows. A property is similar in some ways to an Extended User Attribute, but are not limited to primitive data types such as strings or integers.

Identity Manager defines the `tasks` system property, which is used by the Deferred Task Scanner to cause workflow tasks to be run at some date in the future. The value of the `tasks` property is a list of objects. The following table defines the attributes that belong to objects in the list.

Table 3-8

Attribute	Description
`name`	Identifies the name of the TaskDefinition object to run.
`date`	Specifies the date on which to run the task.
`taskName`	Identifies the TaskInstance that is created. If none is specified, Identity Manager generates a random name.
`owner`	Identifies the name of an Identity Manager administrator that is considered to be the owner of the task. If none is specified, the default owner is Configurator.
`organization`	Identifies the Identity Manager organization that the TaskInstance will be placed in. If none is specified, an organization controlled by the task owner is selected at random.
`description`	Descriptive text that will be stored in the TaskInstance when it is created. This text is displayed in the task status page of the Identity Manager Administrator Interface.

Sample Use

You can use the `accounts[Lighthouse].properties` value to display a table of the deferred tasks assigned to a user. This list is added to the form library named Default User Library, which is found in sample/formlib.xml.

The field that displays the deferred task table is named Deferred Tasks. After modifying the waveset.properties attribute, the deferred task table is now referenced by the default Tabbed User Form. If any deferred tasks exist, the table will be displayed at the bottom of the Identity tab panel.

accounts[Lighthouse].viewUserForm

Used to display a view-only User form. This view-only form displays field information as Labels, to ensure that the administrator cannot change values, although he can list, view, and search on this user information. (The administrator selects a user from the accounts list, then clicks **View** to see user details.)

accounts[<resource>].properties

Used to store account properties in the Identity Manager repository. Use this attribute if you have some information about the account -- for example the date it was created -- that cannot be stored as a native account attribute on the resource.

accounts[<resource>].waveset.forceUpdate

Used to specify a list of resource account attributes that will always be sent to the resource for update when a user is modified and that an attribute value remains available to resource actions. This attribute is required for resource actions to be run when a user is unassigned from a resource.

The following field definition from a user form uses a Solaris resource. (`<resource>` has been replaced with the name of the resource.):

```
<Field name='accounts[waterloo].waveset.forceUpdate'>
   <Default>
      <List>
          <String>delete after action</String>
          <String>Home directory</String>
      </List>
   </Default>
</Field
```

The preceding code causes Identity Manager to send the `delete after action` and `Home directory` attribute to the provisioner and resource adapter.

global Attribute

You can use the global attribute set of the user view to conveniently assign attributes to many resource accounts (including Identity Manager). The value of the *global* attribute is an object whose attributes are referred to as `global attributes`. When the view is saved, the system assigns the value of each global attribute to all resource accounts that define the global attribute name in their schema map. These values are also propagated to the Identity Manager repository if there is an extended attribute with the same name.

For example, two resources *R1* and *R2* define an attribute named `fullname`. When the attribute `global.fullname` is stored in the view, this value is automatically copied into attributes `accounts[R1].fullname` and `accounts[R2].fullname`.

You can also use global attributes to assign extended attributes that are stored in the Identity Manager repository. If a global attribute is also declared as an extended Identity Manager attribute, it is copied into `accounts[Lighthouse]`.

NOTE Do not use `global.accountId` when creating accounts. The account ID is created by the DN templates on the resources. Using `global.accountId` overrides this, which may cause problems.

Referencing Two Different Fullname Attributes

The `global` attribute can be used in combination with the `account` attribute for the same attribute name. For example, on an Active Directory resource, the structure of the `fullname` is `lastname, firstname`. But all other resources that have a `fullname` use `firstname lastname`.

The following example shows how you can reference these two fields in a form.

```
<Field name='global.fullname'>
 <Expansion>
       <concat>
         <ref>global.firstname</ref><s> </s>
         <ref>global.lastname</ref>
       </concat>
 </Expansion>
</Field>
<Field name='accounts[ActiveDir].fullname'>
 <Expansion>
       <concat>
          <ref>global.lastname</ref><s>, </s>
          <ref>global.firstname</ref>
      </concat>
   </Expansion>
</Field>
```

In the preceding example, creating a new user works as expected. However, when you load the user, the `fullname` attribute from the Active Directory resource can be used to populate the `global.fullname` field.

A more accurate implementation for this scenario would be to declare one resource to be the authoritative source for an attribute and create a `Derivation` rule such as the following:

```
<Field name='global.fullname'>
 <Derivation>
       <or>
         <ref>accounts[LDAP res].fullname</ref>
         <ref>accounts[AD res].fullname</ref>
       </or>
 </Derivation>
      <concat>
          <ref>global.firstname</ref><s> </s>
          <ref>global.lastname</ref>
      </concat>
   </Expansion>
</Field>
   <Expansion>
```

By defining a `Derivation` rule, the value of the `fullname` attribute in the LDAP resource will be used first to populate the `fullname` field. If the value does not exist on LDAP, then the value will be set from the AD resource.

accountInfo Attribute

Contains read-only information about resource accounts associated with the user. It is used within system views besides the user view. Some information in this view is a duplicate of the information found in the `waveset.accounts` attribute. There are two reasons for this duplication:

- Information in this view is structured so that it is easier to use in forms
- This view can be used as a component of other views without including the entire `waveset` view.

Most account information is stored in the `accountsInfo.accounts` attribute. Other attributes simply contain lists of account names. It is common to use a `FieldLoop` in a form to iterate over the names in one of the name list attributes, then use this name to index the account list attribute.

For example, the following form element generates a list of labels that contain the names of each resource that is assigned indirectly through a role.

```
   <Field name='accountInfo.accounts[$(name)].name>
      <FieldLoop for='name' in='accountInfo.fromRole'>
        <Display class='Label'/>
```

```
   </Field>
</FieldLoop>
```

The following tables shows the `accountInfo` view attributes, which describe characteristics about the user.

Table 3-9 accountInfo Attributes (User View)

Attribute	Description
`accountInfo.accounts`	Lists objects that contain information about each resource account associated with the user (for example, `created, disabled`).
`accountInfo.assigned`	Lists the resources that are assigned to the user.
`accountInfo.fromRole`	Lists (in flat list format) resources assigned to the user through the role.
`accountInfo.privates`	Lists (in flat list format) resources assigned directly to the user.
`accountInfo.toCreate`	Lists names of all resources currently assigned to the user but for which accounts do not yet exist in Identity Manager.
`accountInfo.toDelete`	Lists names of resources that are no longer assigned to the user, but that are still known to exist.
`accountInfo.types`	Lists each type of resource that is currently assigned to the user or through Reserve Groups.
`accountInfo.typeNames`	Lists unique type names for every assigned resource.

accountInfo.accounts

Contains a list of objects that themselves contain information about each associated resource account. Elements in the accounts list are referenced by name, where the name is the name of the resource.

Example

```
accountInfo.accounts[Active Directory].type
```

Objects found in the `accountInfo.accounts` list have the following attributes, as defined in the following table.

Table 3-10 accountInfo.accounts. Attributes (User View)

Attribute	Description
attributes	Information about all the account attributes defined by this resource.
name	Name of the resource where the account exists or will be created.
id	Repository ID of the resource.
type	Resource type name.
accountId	Name of the user's account on this resource.
assigned	True if the account is currently assigned. Accounts that are not assigned can be deleted by Identity Manager.
protected	True if the account is currently protected. This means that update or delete operations on the account are ignored.
passwordPolicy	Information about the password policy defined for this resource.

accountInfo.accounts[ ].attributes[ ]

Contains information about all the account attributes defined by this resource. These attributes are listed on the schema map page of the resource. The value of the attribute is a List of objects.

The following table defines the attributes that these objects contain.

Table 3-11 accountInfo.accounts. Attributes (User View)

Attribute	Description
name	The name of the Identity Manager resource account attribute. This name is defined in the resource schema map.

Table 3-11 accountInfo.accounts. Attributes (User View)

Attribute	Description
`syntax`	The syntax of the attribute value. The value of the `syntax` attribute is one of the following values. int string boolean encrypted binary complex Refer to the *Identity Manager Resources Reference* to determine if binary or complex attributes are supported for the resource. An exception is thrown if you attempt to send binary or complex attributes to a resource that does not support these attributes. Binary attributes should be kept as small as possible. Identity Manager will throw an exception if you attempt to manage a binary attribute that is larger than 350 KB. Contact Customer Support for guidance if you need to manage attributes larger than 350 KB.
`multi`	True if the attribute allows multiple values.

If you are designing a form, do not worry about the declared resource account attribute types. The user view processing system makes the appropriate type coercions when necessary.

accountInfo.accounts[].passwordPolicy

A resource can be assigned a password policy. If an attribute has an assigned password policy, the value of this attribute will contain information about it.

`The following table defines the attributes in the accountInfo.accounts[resname].passwordPolicy.`

Table 3-12 accountInfo.accounts[resname].passwordPolicy Attributes (User VIew)

Attribute	Description
`name`	The name of policy. This corresponds to the name of a `policy` object in the Identity Manager repository.
`summary`	A brief text description of the policy including information about each of the policy attributes.
`attributes`	The value of this attribute is another object that contains the names and values of each policy attribute.

Applications that display policy information typically display the summary text, but if you need more fine-grained control over the display of each policy attribute, you can use the attributes map.

Forms that provide an interface for changing and synchronizing passwords often use this information.

accountInfo.accounts[Lighthouse]

This special entry in the `accountInfo` list is used to hold information about the Identity Manager default password policy. This is convenient when displaying password forms since information about the Identity Manager password and policies must be displayed along with the information for resource accounts.

This element is present only when pass-through authentication is not being used. The resource type is `Lighthouse`.

accountInfo Resource Name Lists

The `accountInfo` view includes attributes that contain lists of resource names. Each list is intended to be used in forms with `FieldLoop` constructs to iterate over resources with certain characteristics.

The `accountInfo` attributes that can contain resource names are:

- `assigned`
- `created`
- `fromRole`
- `private`
- `toCreate`
- `toDelete`

accountInfo.assigned

Identifies the resources that are assigned to the user. If you are designing a form, you can call this attribute to display a list of resources that are assigned from the role, applications, and that are directly assigned to a user.

accountInfo.typeNames

A list of unique type names for every assigned resource. This is used in `Disable` expressions in forms where you want to disable fields unless a resource of a particular type is selected.

```
<Field name='HomeDirectory' prompt='Home Directory'>
   <Display class='Text'/>
      <Disable>
         <not>
            <contains>
               <ref>accountInfo.typeNames</ref>
               <s>Solaris</s>
            </contains>
         </not>
      </Disable>
</Field>
```

This returns the same information as the path `accountInfo.types[*].name` but is more efficient, which is important when used with `Disable` expressions. This list can include common resource types.

You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator Interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountInfo.types

This attribute contains information about each type of resource that is currently assigned. The value of the attribute is a List (objects).

The following table shows the attributes that belong to each object.

Table 3-13 accountInfo.types Attributes (User VIew)

Attribute	Description
`accounts`	List of `accountIds` for each account assigned to the user that is of this type
`name`	Resource type name

For example, you can determine a list of IDs for all UNIX accounts with the following path:

```
accountInfo.types[Unix].accounts
```

display Attribute

The `display` attribute contains information that relates to the context in which the view is being processed. Most of the attributes are valid only during interactive form processing.

The following table shows the most used `display` view attributes.

Table 3-14 Most Used display Attributes (User VIew)

Attribute	Description
eventType	Indicates whether the user view is servicing a create or update request, as indicated by the values create or update (read-only).
`session`	A handle to an authenticated Identity Manager session. This attribute is valid only during interactive editing session in the Identity Manager Administrator Interface. It is provided as an access point into the Identity Manager repository. The value of this attribute can be passed to methods in the `com.waveset.ui.FormUtil` class. The `display.session` attribute is not valid in the following cases where form processing may occur: in the bulk loader during background reprovisioning in unsynchronized actions or approvals Best practices suggest using this attribute only within a `Property` or `Constraints` element. In almost all existing forms, `display.session` is used only in `Constraints` elements.
`subject`	An object holding information about the credentials of an Identity Manager user or administrator. This value is set in almost all cases, but is typically used in workflow applications called during background activities where the `display.session` is no longer valid. The subject can be used to get a new session. In this case, it is used for gaining access to the repository.
state	A handle to a `_com.waveset.ui.util.RequestState_` object that in turn contains handles to objects related to the HTTP request such as the `_javax.servlet.http.HttpSession_`.

Default itemType Behavior

Typically, only `wizard` itemTypes cause a workflow to transition directly to a WorkItem if the requester is the owner of the workItem.

When `itemType` is set as follows, the workflow will not transition into a WorkItem, but will instead appear under the Approval tab:

- `approval`
- `custom`
- `itemType`

Overriding Default Behavior

You can override behavior in the User view by setting the `allowedWorkItemTransitions` option as a property of the form as follows:

```
<Form ......>
   <Properties>
     <Property name='allowedWorkItemTransitions'>
       <list>
         <s>myCustomType</s>
        </list>
 <     /Property>
    </Properties>
```

Deferred Attributes

A *deferred attribute* is an attribute that derives its value from an attribute value on a different account. You declare the deferred attribute in a view (and the WSUser model), and the provisioning engine performs this substitution immediately before calling the adapter.

If the deferred attribute derives its value from another resource's GUID attribute, the source adapter does not need to take action. However, if the source attribute is not the GUID, the adapter must return the attribute in the ResourceInfo._resultsAttributes map as a side effect of the realCreate operation. If the adapter does not return the attribute, the provisioning engine will fetch the account to get the value. This is less efficient than modifying the adapter to return the value.

When to Use Deferred Attributes

Use deferred attributes when creating new accounts to specify that the value of an account attribute is to be derived from the value of an attribute on a different account that will not be known until the source account has been created. One common example is to set an attribute to the value of the generated unique identifier.

Using Deferred Attributes

There are two main steps to defining a deferred attribute:

1. Ensure that the account is created on the source resource before the second account is created. Do this by creating an ordered Resource Group that contains both resources and assigning the Resource Group to the user.
2. Set the special attributes in the User view for the accounts that are to be created as indicated by the following sample scenario. Each deferred attribute requires two view attributes: one that identifies the source account, and one that identifies the source attribute. Set these using paths of the following form:

   `accounts[<resource>].deferredAttributes.<attname>.resource`

   `accounts[<resource>].deferredAttributes.<attname>.attribute`

   where `<resource>` would be replaced with an actual resource name and `<attname>` replaced with an actual attribute name.

   For example, assume a scenario in which the following two resources are created: 1) a resource named LDAP that generates a `uid` attribute when an account is created; 2)a resource named HR, which contains a `directoryid` attribute named `directoryid`, whose value is to be the same as `uid` in the LDAP resource.

   The following form fields set the necessary view attributes to define this association.

```
<Field name='accounts[HR].deferredAttributes.directoryid.resource'>
   <Expansion><s>LDAP</s></Expansion>
</Field>
<Field name='accounts[HR].deferredAttributes.directoryid
   <Expansion><s>uid</s></Expansion>
</Field>
```

Debugging the User View

When debugging the User view, you might find it useful to dump the contents of the view into a new file. To create a dump file, add the following Derivation statement to the User view:

```
<Field name='DumpView'>
   <Derivation>
      <invoke name='dumpFile'>
```

```
         <ref>form_inputs</ref>
            <s>c:/temp/view.xml</s>
      </invoke>
   </Derivation>
</Field>
```

This Derivation expression invokes the `dumpFile` method, which generates the file after the User form is displayed for the first time. The `form_inputs` variable is automatically bound to the view that is being used with this form.

In the preceding example, the String argument to the `dumpFile` method is a file system path, where you substitute a valid path for `c:/temp/view.xml`.

Account Correlation View

Used to search for users correlating to a specified account (or account attributes). This view is used as part of the account reconciliation process.

This view contains the root attributes listed below. The values of these attributes are GenericObjects. The new ID is <account_name>@<resource_name>

Table 3-15 Top-Level Attributes of Account Correlation View

Attribute	Description
correlation	Contains information about how correlation should be done
matches	Contains the result of the correlation

The correlation request is executed on both the view get operation and refresh request. In the case of a refresh, the request specified in the view is used (with the exception of accountId and resource, as these values are overridden by the view ID). In the case of a get request, view options of the same name as the view attribute (for example, correlator) can be used to specify the view-supplied portion of the request.

NOTE accountAttributes, when provided as a view option, can be supplied as a WSUser (as returned by resource adapter methods) or as a GenericObject.

Correlation

Table 3-16 Attributes of Correlation Attribute (Account Correlation View)

Attribute	Editable?	Data Type	Required?
accountId	Read	String	Yes
accountGUID	Read/Write	String	No (unless if accountId and resource cannot clearly identify the resource)
resource	Read	String	Yes
accountAttributes	Read/Write	String	

Table 3-16 Attributes of Correlation Attribute (Account Correlation View)

Attribute	Editable?	Data Type	Required?
`correlator`	Read/Write	String	No
`confirmer`	Read/Write	String	No

accountId

Specifies the name of the account to correlate. This is automatically obtained from the view ID.

accountGUID

Specifies the GUID of the account to correlate. Required only if `accountId` and `resource` cannot clearly and unambiguously identify the resource.

resource

Specifies the name of the resource where the account resides. This value is automatically obtained from the view ID.

accountAttributes

Specifies the attributes of the account. If present, the viewer will not fetch the current account attributes to pass to the correlation/confirmation rules. Instead, these attributes will be passed in.

correlator

Specifies the correlation rule to use. If not present, the correlation rule specified by reconciliation policy for the resource will be used. If present, but null, no correlation rule is used.

confirmer

Specifies the confirmation rule to use. If not present, the confirmation rule specified by reconciliation policy for the resource will be used. If present, but null, no confirmation rule is used.

These lists consist of GenericObjects that contain the summary attributes of users.

Table 3-17 Attributes of confirmer Attribute (Account Correlation View)

Attribute	Editable?	Data Type
`claimants`	Read	List
`correlated`	Read	List
`unconfirmed`	Read	List

claimant

Lists claimants that are calculated independent of the correlation algorithm, so claimants may also appear in another of the lists. Claimant discovery can be disabled by setting `ignoreClaimants` to true in the view options. A user claims an account if it has a `ResourceInfo` explicitly referencing the account.

correlated

Lists the users who were correlated to the resource account.

unconfirmed

Lists users who were selected by the correlation rule, but were rejected by the confirmation rule. This list is only present if the `includeUnconfirmed` is set to `true` in the view options.

Admin Role View

Used when creating or updating an admin role to a user. *Admin roles* enable you to define a unique set of capabilities for each set of organizations. Capabilities and controlled organizations can be assigned directly or indirectly through roles.

One or more admin roles can be assigned to a single user and one or more users can be assigned the same admin role.

Table 3-18 Top-Level Attributes of Admin Role View

Name	Editable?	Type	Required?
`id`	Read/Write	String	No
`name`	Read/Write	String	Yes
`capabilities`		List	Yes
`capabilitiesRule`		String	Yes
`controlledOrganizations`		List	Yes
`controlledOrganizationsRule`		String	Yes
`controlledOrganizationsUserform`		String	Yes
`controlledSubOrganizations`		List (object)	No
`memberObjectGroup`		List	Yes

id

Uniquely identifies the AdminRole object in Identity Manager. System-generated.

name

Specifies the name of the admin role.

capabilities

Identifies the list of capability names that are assigned to this admin role.

capabilitiesRule

Specifies the name of the rule to be evaluated that will return a list of zero or more capability names to be assigned.

controlledOrganizations

Lists organization names over which the associated capabilities are allowed.

controlledOrganizationsRule

Specifies the name of the rule to be evaluated. This rule will return a list of zero of more controlled organizations names to be assigned.

controlledOrganizationsUserform

Specifies the userform that will be used when editing or creating users in the scope of organizations controlled by this admin role. Valid if the userform is not directly assigned to the user that is assigned this Admin role.

controlledSubOrganizations

Lists the controlled organizations for which a subset of the objects available has been either included or excluded. The value of this attribute consists of a list of `controlledSubOrganization` objects. Each ControlledOrganization object view is as follows.

Table 3-19 controlledSubOrganizations View Attributes (Admin Role view)

Attribute	Data Type	Required?
`name`	String (name of controlled object group)	
`types`	List (objects)	

`types` is a list of objects, where the list of objects to include or exclude are organized by type (for example, Resource, Role, and Policy). The view for each object type is as follows:

Table 3-20 controlledSubOrganizations View Attribute Object Types (Admin Role view)

Attribute	Data Type	Required?
`name`	String	
`include`	List (objects)	
exclude	List (objects)	

name

Specifies the name of the object type.

include

Lists object names of the associated object type to include.

exclude

Lists object names of the associated type to exclude.

memberObjectGroup

Lists the ObjectGroups of which this Admin role is a member. These are the object groups (organizations) that this Admin role is available to.

Change User Answers View

Used to change an existing user's authentication answers for one or more login interfaces.

Contains two high-level attributes.

Table 3-21 Change User Answers View Attributes

Attribute	Editable?	Data Type	Required?
`questions`		List	
`loginInterface`		String	

questions

Describes the question. Contains the following attributes:

Table 3-22 questions Attributes (Change User Answers View)

Attribute	Data Type	Required?
`qid`	String	
`question`	String	
`answer`	String	
`answerObfuscated`	Boolean	

qid

Uniquely identifies a question that is used to associate this question with one defined in the policy.

question

Specifies the question string as defined in the policy.

answer

Specifies the user's answer, if specified, associated with the value of `qid`.

answerObfuscated

Specifies whether the answer is displayed or encrypted.

loginInterface

Identifies the login interface with which this question is associated. Its value is a unique message catalog key for each login interface.

Contains the following attributes:

Table 3-23 loginInterface Attributes (Change User Answers View)

Attribute	Data Type	Required?
name	String	
questionPolicy	String	
questionCount	String	

name

Identifies the name of the login interface that the question is associated with.

Valid values include:

- UI_LOGIN_CONFIG_DISPLAY_NAME_ALL_INTERFACES
- UI_LOGIN_CONFIG_DISPLAY_NAME_ADMIN_INTERFACE
- UI_LOGIN_CONFIG_DISPLAY_NAME_CLI_INTERFACE
- UI_LOGIN_CONFIG_DISPLAY_NAME_DEFAULT_USER_INTERFACE
- UI_LOGIN_CONFIG_DISPLAY_NAME_IVR_INTERFACE
- UI_LOGIN_CONFIG_DISPLAY_NAME_QUESTION_INTERFACE
- UI_LOGIN_CONFIG_DISPLAY_NAME_USER_INTERFACE

questionPolicy

Specifies the policy that this question is associated with (for example, All, Random, Any, or RoundRobin).

questionCount

Set only if the `questionPolicy` attribute is set to Any or Random.

Change User Capabilities View

Used to change an Identity Manager user's capabilities.

Table 3-24 Change User Capabilities View Attributes

Attribute	Editable?	Data Type	Required
adminRoles		List [String]	
capabilities		List [String]	
controlledOrganizations		List [String]	

adminRoles

Lists the Admin roles that are assigned to the user.

capabilities

Lists capabilities assigned to this user.

controlledOrganizations

Lists the organizations that this user controls with the assigned capabilities.

Delegate WorkItems View

Use this view to delegate the work items for specified users.

Top-level attributes include the following:

manager

Specifies the `accountId` of the user whose `workItem` will be deleted. This value is null if the user has no `idmManager` assigned.

name

Identifies the user (by name) whose work items will be delegated.

delegates

Lists delegate objects, indexed by `workItemType`, where each object specifies delegate information for a specific type of work item (`workItem`).

delegatesHistory

Lists delegate objects, indexed from 0 to *n*, where *n* is the current number of delegate history objects up to the delegate history depth. (*Delegate history depth* is the number of previous delegations to keep for reuse. You can configure the number kept in the System Configuration object by setting the `security.delegation.historyLength` attribute to an integer value greater than 0. The default number kept is 10.)

Each of the preceding attributes has the following attributes:

Table 3-25

Attributes of accounts[Lighthouse].delegate* Attributes	Description
`workItemType`	Identifies the type of `workItem` being delegated. See Delegate object model description for valid list of `workItem` types.
`workItemTypeDisplayName`	Specifies a user-friendly `workItem` type name. Identity Manager displays this name in the product interface.
`workItemTypeObjects`	Lists the names of the specific roles, resources, or organizations on which the user is delegating future `workItem` approval requests. This attribute is valid when the value of `workItemType` is `roleApproval`, `resourceApproval`, or `organizationApproval`. If not specified, the value of this attribute default is to delegate future `workItem` requests on all roles, resources, or organizations on which this user is an approver.

Table 3-25

Attributes of accounts[Lighthouse].delegate* Attributes	Description
toType	Type to delegate to. Valid values are: • manager • delegateWorkItemsRule • selectedUsers
toUsers	Lists the names of the users to delegate to (if toType is selectedUsers).
toRule	Specifies the name of the rule that will be evaluated to determine the set of users to delegate to (if toType is delegateWorkItemsRule).
startDate	Specifies the date when delegation will start.
endDate	Specifies the date when delegation will end.
status	Summarizes a delegation based on its start and end dates and whether the delegation appears in the list of current delegations.

Referencing a DelegateWorkItems View Object from a Form

The following code sample illustrates how to reference a DelegateWorkItems view delegate object from a form:

```
<Field name='delegates[*].workItemType'>
<Field name='delegates[*].workItemTypeDisplayName'>
<Field name='delegates[*].workItemTypeObjects'>
<Field name='delegates[*].toType'>
<Field name='delegates[*].toUsers'>
<Field name='delegates[*].toRule'>
<Field name='delegates[*].startDate'>
<Field name='delegates[*].endDate'>
<Field name='delegates[*].status'>
```

where supported index values (*) are workItemType values.

The following code sample illustrates how to reference a delegate history object from the DelegateWorkItems view:

```
<Field name='delegatesHistory[*].workItemType'>
<Field name='delegatesHistory[*].workItemTypeDisplayName'>
<Field name='delegatesHistory[*].workItemTypeObjects'>
<Field name='delegatesHistory[*].toType'>
<Field name='delegatesHistory[*].toUsers'>
<Field name='delegatesHistory[*].toRule'>
<Field name='delegatesHistory[*].startDate'>
<Field name='delegatesHistory[*].endDate'>
<Field name='delegatesHistory[*].selected'>
<Field name='delegatesHistory[*].status'>
```

where supported index values (*) are 0 to *n*, where *n* is the current number of delegate history objects up to delegate history depth.

Table 3-26 Work Item Types

workItem Type	Description	Display Name
Approval	extends WorkItem	Approval
OrganizationApproval	extends Approval	Organization Approval
ResourceApproval	extends Approval	Resource Approval
RoleApproval	extends Approval	Role Approval
Attestation	WorkItem	Access Review Attestation
review	WorkItem	Remediation
accessReviewRemediation	WorkItem	Access

Deprovision View

Used to present and select a list of resources to be deprovisioned. Contains one single top-level attribute.

resourceAccounts

This attribute contain the following attributes.

Table 3-27 resourceAccounts Attributes (Deprovision View)

Name	Editable?	Data Type	Required?
id	Read/Write	String	
selectAll	Read/Write	Boolean	
unassignAll	Read/Write	Boolean	
unlinkAll	Read/Write	Boolean	
currentResourceAccounts	Read	List (objects)	
fetchAccounts	Read/Write	Boolean	
fetchAccountResources	Read/Write	List	

id

Specifies the unique identifier for the account.

selectAll

Controls whether all resources are selected.

unassignAll

Specifies that all resources should be removed from the user's list of private resources.

unlinkAll

Specifies that all resources should be unlinked from the Identity Manager user.

tobeCreatedResourceAccounts

Represents the accounts that are assigned to this Identity Manager user but which have not been created. Passwords cannot be unlocked on accounts that have not yet been created.

tobeDeletedResourceAccounts

Represents the accounts that have been created but are no longer assigned to this user. Passwords cannot be changed on accounts that are going to be deleted.

All three account lists contain objects that describe the state of the account on each resource and allow you to individually select accounts

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager (including the Identity Manager account itself).

All account lists are indexed by resource name.

Table 3-28 currentResourceAccounts Attributes (Deprovision View)

Name	Editable?	Data Type
selected	Read/Write	Boolean
unassign	Read/Write	Boolean
unlink	Read/Write	Boolean
name	Read	String
type	Read	String
accountId	Read	String
exists	Read	Boolean
disabled	Read	Boolean
authenticator	Read	Boolean
directlyAssigned	Read	Boolean

selected

If set to `true`, indicates that for a given resource, the associated account should be deprovisioned. If the selected account is Lighthouse, the Identity Manager user and all associated resource assignments will be deleted unless they are also selected. However, the associated resource accounts will not be deleted.

unassign

If set to `true`, indicates that the specified resource should be removed from the user's list of private resources (for example, `waveset.resources`).

unlink

If set to `true`, indicates that the specified resource should be unlinked from the Identity Manager user (for example, remove the associated ResourceInfo object).

NOTE If selected or unassign are set to true, this suggests that unlink will also be true. However, the converse is not true. unlink can be true and selected and unassign can be set to false.

---

name

Specifies the name of resource. This corresponds to the name of a `resource` object in the Identity Manager repository.

type

Identifies the type of resource, such as Solaris. You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountId

Specifies the identity of the resource account.

exists

Indicates whether the account already exists on the resource or not (only in `currentResourceAccounts`).

disabled

Indicates whether the account is currently disabled or enabled (only in `currentResourceAccount`).

authenticator

Indicates whether the account is one that the user is configured to log in.

directlyAssigned

If `true`, indicates that the account is directly assigned to the user. A value of `false` indicates that the account is indirectly assigned by a role or application.

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See *Setting View Options in Forms* in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See "Setting View Options in Forms" in this chapter for more information.

Disable View

Used to disable accounts on the Identity Manager user. This view is often used in custom workflows.

resourceAccounts

Represents the top-level attribute when accessing attributes in this view.

Table 3-29 Attributes of resourceAccounts Attribute (Disable View)

Name	Editable?	Type	Required?
`id`	Read	String	
`selectAll`	Read	Boolean	
`currentResourcesAccount`	Read	String	
`fetchAccounts`	Read/Write	Boolean	
`fetchAccountResources`	Read/Write	List	

id

Identifies the Identity Manager ID of the user.

selectAll

When set, causes all resource accounts to be disabled, including the Identity Manager account.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager, including the Identity Manager account itself. Use the `selected` field to signify that the specific resource should be enabled.

Table 3-30 resourceAccounts.currentResourceAccounts Attributes (Disable View)

Name	Editable?	Type
`name`	Read	String
`type`	Read	String
`accountId`	Read	String

Table 3-30 resourceAccounts.currentResourceAccounts Attributes (Disable View)

Name	Editable?	Type
`exists`	Read	Boolean
`disabled`	Read	Boolean
`selected`	Read/Write	Boolean

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See *Setting View Options in Forms* in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See *Setting View Options in Forms* in this chapter for more information.

Enable View

Used to enable accounts on the Identity Manager user. This view is often used in custom workflows.

resourceAccounts

Represents the top-level attribute when accessing attributes in this view.

Table 3-31 Attributes of resourceAccounts Attribute (Enable View)

Name	Editable?	Type	Required?
`id`	Read	String	
`selectAll`	Read	Boolean	
`currentResourcesAccount`	Read	String	
`fetchAccounts`	Read/Write	Boolean	
`fetchAccountResources`	Read/Write	List	

id

Identifies the user's Identity Manager ID.

selectAll

When set, all resource accounts will be enabled, including the Identity Manager account.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager, including the Identity Manager account itself. Use the `selected` field to signify that the specific resource should be enabled.

Table 3-32 resourceAccount.currentResourceAccounts Attributes (Enable View)

Name	Editable?	Type
`name`	Read	String
`type`	Read	String
`accountId`	Read	String

Table 3-32 resourceAccount.currentResourceAccounts Attributes (Enable View)

Name	Editable?	Type
`exists`	Read	Boolean
`disabled`	Read	Boolean
`selected`	Read/Write	Boolean

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See *Setting View Options in Forms* in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See "Setting View Options in Forms" in this chapter for more information.

Find Objects View

Provides a customizable, generic Identity Manager repository search interface for any object type defined in Identity Manager that has rights and is not deprecated or restricted to internal use. The Find Objects view handler provides the associated forms for specifying one or more attribute query conditions and parameters and for the display of the find results. In addition, you can use view options to specify attribute query conditions and parameters.

This view contain the following attributes.

Table 3-33 Top-Level Attributes (Find Objects View)

Name	Editable?	Type	Required?
`objectType`	Read/Write	String	Yes
`allowedAttrs`	Read/Write	List	No
`attrsToGet`	Read/Write	List	No
attrConditions	Read/Write	List	No
maxResults	Read/Write	String	No
results	Read	List	No
sortColumn	Read/Write	String	No
selectEnable	Read/Write	Boolean	No

objectType

Specifies the Identity Manager repository object type to find (for example, Role, User, or Resource).

allowedAttrs

Lists the specified object types (specified by the `objectType` attribute) allowed queryable attribute names that are obtained by default by calling the objectType's `listQueryableAttributeAttrs()` method. This method is exposed by each class that extends PersistentObject. If not overridden by the object type class, it inherits the PersistentObject implementation returning the default set of queryable attributes supported by all PersistentObjects.

You can override the default set by specifying the set of `allowedAttrs` in either the default section or the `objectType`-specific section of the findObjectsDefaults.xml configuration file. This file resides in the sample directory. Specify each allowed attribute in the sample/findObjectsDefaults.xml file as follows:

name

Identifies the attribute.

displayName

Specifies the attribute name as it is displayed in the Identity Manager Administrator interface. If not specified, the value of this attribute defaults to the same value as `name`.

syntax

Indicates the data type of attribute value where supported values include `string`, `int`, and `boolean`. If not specified, this value defaults to `string`.

multiValued

Indicates whether the attribute supports multiple values. A value of `true` indicates that attribute supports multiple values. If unspecified, this value defaults to `false`. This attribute applies only if the attribute syntax is `string`.

allowedValuesType

Specifies the name of the Identity Manager type if the allowed values of the attribute are instances of an Identity Manager type (for example, Role or Resource). If not specified, this attribute defaults to null.

If the `name` attribute is an Identity Manager-defined attribute, then only `name` is required. If the attribute `name` is an extended attribute, you must specify at least the `name` and, optionally, the other attributes unless the defaults are sufficient.

See `sample/findObjectsDefaults.xml` for example formats for specification of allowed attributes.

You can specify the list of `allowedAttrs` as either a list of strings, a list of objects, or a combination of both.

attrsToGet

Lists the summary attribute names of the specified object types (`objectType`) to be returned with each object that match the specified attribute query conditions. You can obtain the object type's set of supported summary attributes by calling the object type's `listSummaryAttributeAttrs()` method. (This method is exposed by each class that extends PersistentObject.) If not overridden by the `objectType` class, it inherits the PersistentObject implementation that returns the default set of summary attributes that are supported by all Persistent Objects.

You can override the default by specifying the list of `resultColumnNames` in either the default section or the `objectType`-specific section of the sample/findObjectsDefaults.xml configuration file.

attrConditions

Lists the attribute conditions that are used to find objects of the specified object type (`objectType`) that match the specified attribute conditions (`attrConditions`). Each attribute condition in the list should be specified as follows:

selectedAttr

Identifies one of the attribute names from the list of allowed attributes (`allowedAttrs`).

selectedAttrRequired

(Optional) Indicates whether the selected attribute (`selectedAttr`) can be changed for this attribute condition. A value of `true` indicates that the selected attribute cannot be changed for this attribute condition, and the attribute condition cannot be removed from the list of attribute conditions

defaultAttr

(Optional) Identifies the `allowedAttrs` name to select by default when the list of allowed attributes is displayed in interface.

allowedOperators

Lists the operators allowed based on the syntax specified in the selected attribute (`selectedAttr`). By default, this list is obtained by calling the `getAllowedOperators` method passing the values of the `syntax` and `multiValued` attributes of the selected attribute (`selectedAttr`). You can override the default by specifying the set of allowed operators (`allowedOperators`) in either the default section or the `objectType`-specific section of the sample/findObjectsDefaults.xml configuration file.

selectedOperator

Specifies the name of one operator from the list specified in `allowedOperators`.

selectedOperatorRequired

(Optional) Indicates whether the selected operator (`selectedOperator`) can be changed for this attribute condition. A value of `true` indicates that the selected operator cannot be changed for this attribute condition, and the attribute condition cannot be removed from the list of attribute conditions

defaultOperator

(Optional) Specifies the name of the operator (`allowedOperators`) to select by default when the list of allowed operators (`allowedOperators`) is displayed in the form.

value

Indicates the value or operand for the selected attribute name and operator that must be tested when Identity Manager determines if it should return an object of the specified object type (`objectType`). You can omit this attribute if the value of `selectedOperator` is `exists` or `notPresent`.

valueRequired

(Optional) Indicates whether the `value` of the attribute condition can be changed. A value of `true` indicates that value can be changed. It also indicates that the attribute condition cannot be removed from the list of attribute conditions.

removeAttrCond

Determines if this attribute condition should be removed or not (internal).

You can specify attribute conditions as view options by using the FindObjects.ATTR_CONDITIONS constant or the `attrCondition` string. If `attrConditions` is not specified, Identity Manager returns all objects of the specified object type.

maxResults

(Optional) Specifies the maximum number of objects of the specified `objectType` that Identity Manager should return from the find request. Defaults to 100 if not specified. You can override the default by specifying the a value for `resultMaxRows` attribute in either the default section or the `objectType`-specific section of the sample/findObjectsDefaults.xml configuration file.

Use of this attribute can improve performance in cases where many Identity Manager repository objects of the specified type exist.

results

If the value of `attrsToGet` is null, the value of `result` is a list of object names that match the specified attribute condition. If the value of `attrsToGet` is non-null, `results` is a list of objects that matched the specified `attrConditions`, where each object consists of:

- *columns* - Lists displayable column names that match the requested `attrsToGet`
- *rows* - Lists *row* objects named from 0 to the number of rows (for example, '10')
- *row* - Lists objects that consist of a name from '0' to the number of columns (for example, '6') and a value for that *rows* column

sortColumn

(Optional) Indicates the value of the column to sort the results on. Defaults to '0' if not specified. You can override the default by specifying a value for `resultSortColumn` in either the default section or the `objectType`-specific section of the sample/findObjectsDefaults.xml configuration file.

selectEnable

(Optional) Specifies whether more than one result row can be selected simultaneously. A value of `true` indicates that more than one result row can be selected. The default is `false`. The default can be overridden by specifying a value for `resultSelectEnable` in either the default section or the `objectType`-specific section of the sample/findObjectsDefaults.xml configuration file.

Org View

Used to specify the type of organization created and options for processing it.

Common Attributes

The high-level attributes of this view are listed in the following table.

Table 3-34 Org View Attributes

Name	Editable?	Data Type	Required?
orgName	Read	String	System-Generated
orgDisplayName	Read/Write	String	Yes
orgType	Read/Write	String	No
orgId	Read	String	System-Generated
orgAction	Write	String	No
orgNewDisplayName	Write	String	No
orgParentName	Read/Write	String	No
orgChildOrgNames	Read	List	System-Generated
orgApprovers	Read/Write	List	No
allowsOrgApprovers	Read	List	System-Generated
allowedOrgApproverIds	Read	List	System-Generated
orgUserForm	Read/Write	String	No
orgViewUserForm	Read/Write	String	No
orgPolicies	Read/Write	List	No
orgAuditPolicies	Read/Write	List	No
renameCreate	Read/Write	String	No
renameSaveAs	Read/Write	String	No

orgName

Identifies the UID for the organization.This value differs from most view object names because organizations can have the same short name, but different parent organizations.

orgDisplayName

Specifies the short name of the organization. This value is used for display purposes only and does not need to be unique.

orgType

Defines the organization type where the allowed values are `junction` or `virtual`. Organizations that are not of types `junction` or `virtual` have no value.

orgId

Specifies the ID that is used to uniquely identify the organization within Identity Manager.

orgAction

Supported only for directory junctions, virtual organizations, and dynamic organizations. Allowed value is `refresh`. When an organization is a directory junction or virtual organization, the behavior of the refresh operation depends on the value of `orgRefreshAllOrgsUserMembers`.

orgNewDisplayName

Specifies the new short name when you are renaming the organization.

orgParentName

Identifies the full pathname of the parent organization.

orgChildOrgNames

Lists the Identity Manager interface names of all direct and indirect child organizations.

orgApprovers

Lists the Identity Manager administrators who are required to approve users added to or modified in this organization.

allowedOrgApprovers

Lists the potential user names who could be approvers for users added to or modified in this organization.

allowedOrgApproverIds

Lists the potential user IDs who could be approvers for users added to or modified in this organization.

orgUserForm

Specifies the `userForm` used by members users of this organization when creating or editing users.

orgViewUserForm

Specifies the view user form that is used by member users of this organization when viewing users.

orgPolicies

Identifies policies that apply to all member users of this organization. This is a list of objects that are keyed by type string: Each policy object contains the following view attributes, which are prefixed by `orgPolicies[<type>].` `<type>` represents policy type (for example, Lighthouse account).

- `policyName` -- Specifies name
- `id` -- Indicates ID
- `implementation` -- Identifies the class that implements this policy.

orgAuditPolicies

Specifies the audit policies that apply to all member users of this organization.

renameCreate

When set to true, clones this organization and creates a new one using the value of `orgNewDisplayName`.

renameSaveAs

When set to true, renames this organization using the value of `orgNewDisplayName`.

Directory Junction and Virtual Organization Attributes

Table 3-35 Directory Junction and Virtual Organization Attributes

Name	Editable?	Data Type	Required?
orgContainerId	Read	String	System-generated
orgContainerTypes	Read	List	System-generated
orgContainers	Read	List	System-generated
orgParentContainerId	Read	String	System-generated
orgResource	Read/Write	String	yes, if directory junction or virtual organization
orgResourceType	Read	String	System-generated
orgResourceId	Read	String	System-generated
orgRefreshAllOrgsUserMembers	Write	String	No

orgContainerId

Specifies the dn of the associated LDAP directory container (for example, cn=foo,ou=bar,o=foobar.com).

orgContainerTypes

Lists the allowed resource object types that can contain other resource objects.

orgContainers

Lists the base containers for the resource used by the Identity Manager interface to display a list to choose from.

orgParentContainerId

Specifies the dn of the associated parent LDAP directory container (for example, ou=bar,o=foobar.com).

orgResource

Specifies the name of the Identity Manager resource used to synchronize directory junction and virtual organizations (for example, West Directory Server).

orgResourceType

Indicates the type of Identity Manager Resource from which to synchronize directory junction and virtual organizations (for example, LDAP).

orgResourceId

Specifies the ID of the Identity Manager resource that is used to synchronize directory junctions and virtual organizations.

orgRefreshAllOrgsUserMembers

If `true` and if the value of `orgAction` is `refresh`, synchronizes Identity organization user membership with resource container user membership for the selected organization and all child organizations. If `false`, resource container user membership will not be synchronized, only the resource containers to Identity organizations for the selected organization and all child organizations.

Dynamic Organization Attributes

Table 3-36 Dynamic Organization Attributes

Name	Editable?	Data Type	Required?
orgUserMembersRule	Read/Write	String	No
orgUserMembersRuleCacheTimeout	Read/Write	String	No

orgUserMembersRule

Identifies (by name or UID) the rule whose `authType` is UserMembersRule, which is evaluated at run-time to determine user membership.

orgUserMembersCacheTimeout

Specifies the amount of time (in milliseconds) before the cache times out if the user members returned by the orgUserMembersRule are to be cached. A value of 0 indicates no caching.

Password View

Used by administrators to change passwords of the Identity Manager user or their resource accounts.

This view contains one top-level attribute.

resourceAccounts

This attribute contains the following attributes.

Table 3-37 ResourceAccounts Attributes (Password View)

Attribute	Editable?	Data Type	Required?
id	Read/Write	String	Yes
`selectAll`	Read/Write	Boolean	No
`currentResourceAccounts`	Read	List (object)	No
`tobeCreatedResourceAccounts`	Read	List (object)	No
`tobeDeletedResourceAccounts`	Read	List (object)	No
`password`	Read/Write	encrypted	Yes
`confirmPassword`	Read/Write	encrypted	Yes, if view is being used interactively
`fetchAccounts`	Read/Write	Boolean	
`fetchAccountResources`	Read/Write	List	

id

Specifies the account ID of the Identity Manager user whose passwords are being changed. Typically set by the view handler and never modified by the form.

selectAll

Controls whether all password are selected.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager (including the Identity Manager account itself).

tobeCreatedResourceAccounts

Represents the accounts that are assigned to this Identity Manager user but which have not been created. Passwords cannot be changed on accounts that have not yet been created.

tobeDeletedResourceAccounts

Represents the set of resources assigned to this user that are not yet being managed by Identity Manager (for example, they do not have an associated `resinfo` object). Passwords cannot be changed on accounts that are going to be deleted.

All three account lists contain objects that describe the state of the account on each resource and allow you to individually select accounts

Both resource account list are indexed by resource name, and will contain objects that describe the resources on which this user has accounts.

Table 3-38 tobeDeletedResourceAccounts Attributes (PasswordView)

Attribute	Editable?	Data Type
selected	Read/Write	Boolean
`name`	Read	String
`type`	Read	String
`accountId`	Read	String
`exists`	Read	Boolean (only in `currentResourceAccounts`
`disabled`	Read	Boolean (only in `currentResourceAccounts`)
`passwordPolicy`	Read	Object
`authenticator`	Read	Boolean
`changePasswordLocation`	Read	String (only in `currentResourceAccounts`)
expirePassword	Read/Write	Boolean

password

Specifies the new password you want to assign to the Identity Manager account or the resource accounts.

confirmPassword

Confirms the password specified in the `password` attribute. When the view is used interactively, the form requires you to enter the same values in the `password` and `confirmPassword` fields. When the view is used programmatically, such as within a workflow, the `confirmPassword` attribute is ignored. If you are using this view interactively, you must set this attribute.

selected

Indicates that the specified resource should receive the new password.

name

Specifies the name of resource. This corresponds to the name of a `resource` object in the Identity Manager repository.

type

Identifies the type of resource, such as `Solaris`. You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountId

Specifies the identity of the account on this resource, if one has been created.

exists

Indicates whether the account already exists on the resource.

disabled

Indicates whether the account is currently disabled.

passwordPolicy

When set, describes the password policy for this resource. Can be null. It contains these attributes.

Table 3-39 passwordPolicy Attributes (PasswordView)

Attribute	Description
`name`	String
`summary`	String

In addition, it contains view attributes for each of the declared policy attributes. The names of the view attributes will be the same as defined in the policy.

The summary string contains a pre-formatted description of the policy attributes.

authenticator

If `true`, indicates that this resource is serving as the pass-through authentication resource for Identity Manager.

changePasswordLocation

(Optional) Describes the location where the password change should occur (for example, the DNS name of a domain controller for Active Directory). The format of the value of this field can vary from resource to resource.

expirePassword

Can be set to a non-null Boolean value to control whether the password is marked as expiring immediately after it has been changed. If null, the password expires by the default if the user whose password is being changed differs from the user that is changing the password.

tobeCreatedResourceAccounts

Represents the accounts that are assigned to this Identity Manager user but which have not been created. Passwords cannot be changed on accounts that have not yet been created.

tobeDeletedResourceAccounts

Represents the accounts that have been created but are no longer assigned to this user. Passwords cannot be changed on accounts that are going to be deleted.

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See Setting View Options in Forms in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See Setting View Options in Forms in this chapter for more information.

Process View

Used to launch tasks such as workflows or reports. The task to be launched must be defined by a TaskDefinition or TaskTemplate object in Identity Manager. Launching the task results in the creation of a TaskInstance object.

This view contains one top-level attribute named `task`. All other top-level attributes are arbitrary and are passed as inputs to the task.

task

This top-level attribute defines how the task is to be launched.

Table 3-40 Process View Attributes

Attribute	Editable?	Data Type	Required?
`process`	Read/Write	String	Yes
`taskName`	Read/Write	String	Yes
`organization`	Read/Write	String	Yes
`taskDisplay`	Read/Write	String	No
`description`	Read/Write	String	No
`execMode`	Read/Write	String	No
`result`	Read/Write	WavesetResult	No
`owner`	Read/Write	String	No

process

Names the process to launch. This can be the name of a TaskDefinition or TaskTemplate object in Identity Manager. It can also be an abstract process name mapped through the `process` settings in the System Configuration object. This attribute is required.

taskName

Specifies the name given to the TaskInstance object that is created to hold the runtime state of the task. If this attribute is not set, a random name is generated.

organization

Names the organization in which to place the TaskInstance. If this attribute is not set, the TaskInstance is placed in Top.

taskDisplay

Specifies a display name for the TaskInstance.

description

Specifies a descriptive string for the TaskInstance. This string is displayed in the Manage Tasks table in the product interface.

execMode

Specifies execution mode. This is typically not specified, in which case the execution mode is determined by the TaskDefinition. Setting this attribute overrides the value in the TaskDefinition.

Allowed `execMode` values are:

Table 3-41 execMode Attribute Values (Process View)

Value	Description
`sync`	Specifies synchronous or foreground execution
`async`	Specifies asynchronous or background execution
`asyncImmediate`	Specifies asynchronous with immediate thread launch

Use the `asyncImmediate` execution mode only for special system tasks that must pass non-serializable values into the task through the view. The task thread is started immediately. The default behavior is to save the TaskInstance temporarily in the repository and have the Scheduler resume it later.

result

Specifies the initial result for the TaskInstance. You can use this setting to pass information into the task that you eventually want displayed with the task results when the task completes.

owner

Specifies the user name that is considered to be the owner of the task. If not set, the currently logged-in user is designated as the owner.

View Options

The following options are recognized by the createView and checkinView methods.

endUser

Specifies that the task is being launched from the Identity Manager User Interface. This allows users with no formal privileges to launch specially designated end-user tasks.

process

Names the process to launch. This name is recognized by the createView method and becomes the value of the process attribute in the view.

suppressExecuteMessage

When set to `true`, suppresses a default message that is added to the task result when an asynchronous task is launched. The default English text is, `The task is being executed in the background`.

Checkin View Results

The following named result items can be found in the WavesetResult object that is returned by the checkinView method.

Table 3-42 Checkin View Results

Result	Description
`taskId`	Identifies the repository ID of the TaskInstance
`taskState`	Identifies the current state of the TaskInstance. It will be one of: ready, executing, suspended or finished
`extendedResults`	When set to `true`, indicates that the TaskInstance will have extended results.

Reconcile View

Used to request or cancel reconciliation operations on a resource. This view is used to perform on-demand reconciliation as part of a workflow. It can also be used when implementing a custom scheduler for reconciliation.

This view is write-only. get and checkout operations are not supported.

request

Specifies the operation to perform. You must specify one of the following valid operations:

Table 3-43 Valid Operations for request Attribute (Reconcile View)

Operation	Description
FULL	Starts a full reconciliation of the resource
INCREMENTAL	Starts an incremental reconciliation of the resource
ACCOUNT	Starts a reconciliation of the account
CANCEL	Cancels the currently active resource reconciliation process

accountId

Identifies the account to reconcile. This string is ignored if the request is not ACCOUNT.

Examples

- To request a reconciliation of a single account on a resource (in this case, an Active Directory resource):

```
request = "ACCOUNT"

accountId = "cn=maurelius, ou=Austin, DC=Waveset, DC=com"
```

- To cancel the pending or currently active reconciliation process on a resource:

```
request = "CANCEL"
```

Reconcile Policy View

Used to view and modify reconciliation policy, which is stored as part of the Identity Manager system configuration object.

Reconciliation Policies and the Reconcile Policy View

Reconciliation policy settings are stored in a tree structure with the following general structure:

- default, or global, policy (`Default`). This is the root policy level.
- resource type (`ResType:`) policy
- resource policy (`Resource:`)

Settings can be specified at any point in the tree. If a level does not specify a value for a policy, it is inherited from the next highest policy.

The view represents an effective policy at a specified point in the policy tree, which is identified by the view name.

Table 3-44 ReconcilePolicy Tree and View Names

View Name	Description
`Default`	Addresses the root of the policy tree
`ResType:`*resource type*	Addresses the specified resource type beneath the root
`Resource:`*resource name*	Addresses the specified resource beneath the resource's resource type

Policy Values

Values of policy settings are always *policy values*. Policy values can contain up to three components, as described in the following table.

Table 3-45 Policy Value Settings Attributes (ReconcilePolicy View)

Policy Value Settings	Description
`value`	Specifies the value of the setting.

Table 3-45 Policy Value Settings Attributes (ReconcilePolicy View)

Policy Value Settings	Description
scope	Identifies the scope from which this setting is derived. Values of scope include Local, ResType, and Default, indicating which level is specifying this policy. For example, a value of SCOPE_LOCAL indicates the value is set at the current policy level. SCOPE_LOCAL -- Policy is set at the resource level or current policy level SCOPE_RESTYPE -- Policy is set at the restype, or resource type, level SCOPE_GLOBAL. -- Policy is set at the global level
inheritance	Identifies the policy setting that is inherited at this level. If the scope is not Local, the inheritance will match the effective value. Not present on policy settings at the Default level.

Authorization Required

To modify the view, users require Reconcile Administrator Capability.

To access the view, users require Reconcile Administrator or Reconcile Request Administrator capabilities.

View Attributes

The following table lists the high-level attributes of this view.

Table 3-46 ReconcilePolicy View Attributes

Attribute	Description
scheduling	Contains information about automated scheduling of reconciles.
correlation	Contains information about how ownership of resource accounts is determined.
workflow	Contains information about user-supplied extensions to the reconciliation process.
response	Contains information about how reconciliation should respond to discovered situations.
resource	Contains information about how reconciliation interacts with the resource.

scheduling

Table 3-47 scheduling Attributes (ReconcilePolicy View)

Attribute	Editable?	Data Type
`reconcileServer`	Read/Write	String
`reconcileModes`	Read/Write	String
`fullSchedule`	Read/Write	Schedule
`incrementalSchedule`	Read/Write	Schedule
`nextFull`	Read	Date
nextIncremental	Read	Date

reconcileServer

Specifies the reconciliation server that should be used to perform scheduled reconciliations.

reconcileModes

Specifies the reconciliation modes that are enabled. Valid values are: `BOTH`, `FULL`, `NONE`.

fullSchedule

Identifies the schedule for full reconciles when enabled.

incrementalSchedule

Identifies the schedule for incremental reconciles when enabled.

nextFull

Containing the time of the next incremental reconcile, if enabled.

nextIncremental

Specifies the repetition count for the schedule. Schedule values are GenericObjects with the following attributes:

- count -- Specifies the repetition count for the schedule
- units -- Specifies the repetition unit for the schedule
- time -- Specifies the start time for the schedule

correlation

Identifies the name of the correlation rule.

Table 3-48 correlation rules (ReconcilePolicy View)

Attribute	Editable?	Data Type
correlationRule	Read/Write	String
confirmationRule	Read/Write	String

correlationRule

Identifies the name of the correlation rule to use when correlating accounts to users.

confirmationRule

Identifies the name of the confirmation rule to use when confirming correlated users against accounts. When no confirmation is required, specify the value CONFIRMATION_RULE_NONE.

workflow

Table 3-49 workflow Attributes (ReconcilePolicy View

Attribute	Editable?	Data Type
proxyAdministrator	Read/Write	String
preReconWorkflow	Read/Write	String
perAccountWorkflow	Read/Write	String
postReconWorkflow	Read/Write	String

proxyAdministrator

Specifies the name of the user with administrative capabilities.

preReconWorkflow, perAccountWorkflow, postReconWorkflow

Specifies the name of the workflow to run at appropriate point in reconciliation processing. To specify that no workflow be run, use the value AR_WORKFLOW_NONE.

response

Table 3-50 response Attributes (ReconcilePolicy View)

Attribute	Editable?	Data Type
`situations`	Read/Write	List
`explanations`	Read/Write	Boolean

situations

Specifies the automated response to perform for the specified situation. Valid responses are:

Table 3-51 situations Options (ReconcilePolicy View

Response	Description
DO_NOTHING	Performs no automated response
CREATE_NEW_USER	Creates new user based on the resource account
LINK_ACCOUNT	Assigns the account to the claiming user
CREATE_ACCOUNT	Recreates the account on the resource
DELETE_ACCOUNT	Removes the account from the resource
DISABLE_ACCOUNT	Disables the account on the resource

explainActions

Specifies whether reconciliation should record detailed explanations of actions in the Account Index.

resource

Table 3-52 resource Attributes (ReconcilePolicy View

Attribute	Editable?	Data Type
`reconcileNativeChanges`	Read/Write	Boolean
`reconciledAttributes`	Read/Write	List (of Strings)
listTimeout	Read/Write	Integer
fetchTimeout	Read/Write	Integer

reconcileNativeChanges

Specifies whether native changes to account attributes should be reconciled.

reconciledAttributes

Specifies the list of account attributes that should be monitored for native changes

listTimeout

Specifies (in milliseconds) how long reconciliation should wait for a response when enumerating the accounts present on the resource.

fetchTimeout

Specifies (in milliseconds) how long reconciliation process should wait for a response when fetching an account from a resource.

Reconcile Status View

Used to obtain the status of the last requested reconciliation operation. This view is read-only.

status

Indicates the status code request (string). Valid status codes include:

Table 3-53 ReconcileStatus View Attributes

Status Code	Description
UNKNOWN	Status cannot be determined. The value of the other attribute is unspecified.
PENDING	Request was received, but has not been processed yet.
RUNNING	Request is currently being processed.
COMPLETE	Request has completed. Consult the attributes to determine the success or failure of the other request.
CANCELLED	Request was cancelled by an administrator.

reconcileMode

Indicates the reconciliation mode of the request. Either FULL or INCREMENTAL.

reconciler

Identifies the Identity Manager server that is processing the reconciliation request.

requestedAt

Indicates the date on which the request was received.

startedAt

Specifies a date on which the reconciliation operation started. If the reconciliation operation has not yet started or was cancelled while still pending, this value is null.

finishedAt

Indicates the date on which the reconciliation operation completed. If the reconciliation process has not yet completed, this value is null.

errors.fatal

Describes the error (if any) that terminated the reconciliation operation. Errors are returned as a list of strings.

errors.warnings

Describes any non-fatal errors that are encountered during the reconciliation operation. Errors are returned as a list of strings.

statistics.accounts.discovered

Identifies the number of accounts that is found on the resource at the time of the reconciliation operation.

statistics.situation[<situation>].resulting

Identifies the number of accounts in the specified reconciliation situation after responses have been performed (successfully or not).

Valid situations are any of the following:

- CONFIRMED
- FOUND
- DELETED
- MISSING
- COLLISION
- UNMATCHED
- UNASSIGNED
- DISPUTED

Rename User View

Used to rename the Identity Manager and resource account identities. This view is typically used when a user in a company has a name change. The other main use for this view is to change the identity of a directory user that essentially causes a move in the directory structure.

Table 3-54 RenameUser View Attributes

Name	Editable?	Data Type	Required?
`newAccountId`	Read/Write	String	
`toRename`	Read	List	
`noRename`	Read	List	
`resourceAccounts`	Read		
`fetchAccounts`	Read/Write	Boolean	
`fetchAccountResources`	Read/Write	List	

newAccountId

Specifies the new `accountId` to be set on the Identity Manager user and used in the Identity templates for resource accounts.

toRename

Specifies a list of accounts in the `currentResourceAccounts` list that support the rename operation.

noRename

Specifies a list of accounts that do not support the rename functionality.

resourceAccounts

Contains mostly read-only information about the resource accounts. Use the following attributes to rename resource accounts:

Table 3-55 resourceAccounts Attributes

Attribute	Type	Description
`selectAll`	Boolean	Controls whether all accounts are renamed.

Table 3-55 resourceAccounts Attributes

Attribute	Type	Description
currentResourceAccounts [<resourcename>].selected	Boolean	Indicates that the new accountId should be used to rename the identity of this resource account.
currentResourceAccounts [Lighthouse].selected	Boolean	Controls whether the Identity Manager account is renamed. selectAll=true overrides this setting.

accounts[<resourcename>].identity

Overrides the use of the Identity Template to create the accountId for this resource account.

accounts[<resourcename>].<attribute>

Used when not specifying the accounts[<resourcename>].identity attribute to pass attributes to the Identity Template for the creation of the new accountId.

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See Setting View Options in Forms in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See Setting View Options in Forms in this chapter for more information.

Example

```
renameView.newAccountId="saurelius"
renameView.resourceAccounts.selectAll="false"
renameView.resourceAccounts.currentResourceAccounts[Lighthouse].selecte
d="true"
renameView.accounts[AD].identity="cn=saurelius,OU=Austin,DC=Waveset,DC=
com"
renameView.resourceAccounts.currentResourceAccounts[AD].selected="true"
renameView.accounts[LDAP].identity="CN=saurelius,CN=Users,DC=us,DC=com"
```

```
renameView.newAccountId="saurelius"
renameView.resourceAccounts.currentResourceAccounts[LDAP].selected="tru
e"
renameView.accounts[AD].identity="Marcus Aurelius"
renameView.resourceAccounts.currentResourceAccounts[AD].selected="true"
```

Reprovision View

Used to present and select the list of resources to be reprovisioned. This view contains one top-level attribute (resourceAccounts).

resourceAccounts

This attribute contains the following attributes.

Table 3-56 resourceAccounts Attributes (Reprovision View)

Name	Editable?	Data Type	Required?
id	Read	String	
`selectAll`	Read/Write	Boolean	
`currentResourceAccounts`	Read	List (objects)	
`fetchAccounts`	Read/Write	Boolean	
`fetchAccountResources`	Read/Write	List	

id

Specifies the unique identifier for the account.

selectAll

Controls whether all resources are selected.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager (including the Identity Manager account itself).

All account lists are indexed by resource name.

Table 3-57 currentResourceAccounts Attributes (Reprovision View)

Name	Editable?	Data Type
`selected`	Read/Write	Boolean
name	Read	String
type	Read	String

Table 3-57 currentResourceAccounts Attributes (Reprovision View)

Name	Editable?	Data Type
accountId	Read	String
exists	Read	Boolean
disabled	Read	Boolean
authenticator	Read	Boolean

selected

If set to `true`, indicates that for a given resource, the associated account should be reprovisioned. If the selected account is Lighthouse, the Identity Manager user and all associated resource assignments will be reprovisioned unless they are also selected. However, the associated resource accounts will not be reprovisioned.

name

Specifies the name of the resource. This corresponds to the name of a `resource` object in the Identity Manager repository.

type

Identifies the type of resource, such as Solaris. You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountId

Specifies the identity of the resource account.

exists

Indicates whether the account already exists on the resource or not (only in `currentResourceAccounts`).

disabled

Indicates whether the account is currently disabled or enabled (only in `currentResourceAccount`).

authenticator

Indicates whether the account is one that the user is configured to login.

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See Setting View Options in Forms in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all assigned resources.

See Setting View Options in Forms in this chapter for more information.

Reset User Password View

Used by administrators to reset a password to a randomly generated password and optionally propagate the new password to resource accounts.

resourceAccounts

Defines characteristics of resource accounts. This attribute contains the following attributes.

Table 3-58 resourceAccounts Attributes (Reset User Password View)

Attribute	Editable?	Data Type	Required?
id	Read	String	
`selectAll`	Read/Write	Boolean	
`currentResourceAccounts`	Read	List (object)	
`tobeCreatedResourceAccounts`	Read	List (object)	
`tobeDeletedResourceAccounts`	Read	List (object)	

id

Specifies the account ID of the Identity Manager user whose passwords are being changed.

selectAll

Controls whether all passwords are selected.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager (including the Identity Manager account itself).

tobeCreatedResourceAccounts

Represents the accounts that are assigned to this Identity Manager user but which have not been created. Passwords cannot be changed on accounts that have not yet been created.

tobeDeletedResourceAccounts

Represents the accounts that have been created but are no longer assigned to this user. Passwords cannot be changed on accounts that are scheduled for deletion.

The three account list attributes -- `tobeDeletedResourceAccounts`, `tobeCreatedResourceAccounts`, and `currentResourceAccounts` -- contain the attributes described in the following table. These attributes describe the state of the account on each resource and allow you to individually select accounts.

Table 3-59 tobeDeletedResourceAccounts Attributes (Reset User Password View

Attribute	Editable?	Data Type	Required?
selected	Read/Write	Boolean	
`name`	Read	String	
`type`	Read	String	
`accountId`	Read	String (only in `currentResourceAccounts`)	
`exists`	Read	Boolean (only in `currentResourceAccounts`	
`disabled`	Read	Boolean (only in `currentResourceAccounts`)	
`passwordPolicy`	Read	Object	
`authenticator`	Read	Boolean	
`changePasswordLocation`	Read	String	

selected

Set to `true` if this account is to have its password reset.

name

Specifies the name of resource. This corresponds to the name of a `Resource` object in the Identity Manager repository.

type

Identifies the type of resource, such as Solaris. You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountId

Specifies the identity of the account on this resource, if one has been created.

exists

Indicates whether the account already exists on the resource.

disabled

Indicates whether the account is currently disabled.

passwordPolicy

When set, describes the password policy for this resource. Can be null. It contains these attributes.

Table 3-60 Reset User Password Attributes (Reset User Password View)

Attribute	Data Type	Editable?	Required?
`name`	String		
`summary`	String		

In addition, it contains view attributes for each of the declared policy attributes. The names of the view attributes will be the same as the WSAttribute in the Policy.

The summary string contains a pre-formatted description of the policy attributes.

authenticator

If `true`, indicates that this resource is serving as the pass-through authentication resource for Identity Manager.

changePasswordLocation

Describes the location where the password change should occur (for example, the DNS name of a domain controller for Active Directory). The format of the value of this field can vary from resource to resource.

Resource View

Used when modifying resources.

Specifically, the view handler that creates this view instantiates resource parameters for the various view methods as follows:

- The `createView` method requires a `typeString` option, which is used to locate the correct prototypeXML for the resource type. The prototypeXML contains the initial set of resource parameters and their initial values. Thus, the view is populated with this list of initial resource parameters and their default values.
- The `getView` and `checkoutView` methods return only the resource parameters that exist in the resource object. The prototypeXML is not used to fill in this list if any resource parameters are missing in the actual resource object.
- The `checkinView` method replaces the list of resource parameters in the stored resource object in the repository. Again, the prototypeXML is not used to fill in any missing resource parameters that are not supplied during the `checkinView` operation.

  The `checkinView` method launches the Manage Resource workflow, which actually commits the changes to the repository. You can modify this workflow to include approvals or notifications.

Top Level Attributes

Top level attributes of this view include:

Table 3-61 Resource View Attributes

Attribute	Editable?	Data Type	Required?
`accountAttributes`	Read/Write	List (Views)	No
`accountId`	Read/Write	String	No
`accountPolicy`	Read/Write	String	No
`adapterClassName`	Read/Write	String	Yes
`allowedApprovers`	Read	List (Strings)	No
`allowedApproversIds`	Read	List (Strings)	No
`approvers`	Read/Write	List (Strings)	No
`available`	Read	View	N/A
`description`	Read	String	No

Table 3-61 Resource View Attributes

Attribute	Editable?	Data Type	Required?
displayName	Read	String	No
excludedAccountsRule	Read/Write	String	No
facets	Read	String	No
identityTemplate	Read/Write	String	No
name	Read/Write	String	Yes
organizations	Read/Write	List (Strings)	Yes
passwordPolicy	Read/Write	String	No
resourceAttributes	Read/Write	List (Views)	No
resourcePasswordPolicy	Read/Write	String	No
retryMax	Read/Write	Integer	No
retryDelay	Read/Write	Integer	No
retryEmail	Read/Write	String	No
retryEmailThreshold	Read/Write	Integer	No
startupType	Read/Write	String	No
syncSource	Read/Write	Boolean	No
typeDisplayString	Read/Write	String	Yes
typeString	Read/Write	String	Yes

accountAttributes

Define the accounts managed on this resource. Attributes vary depending on the resource type, and correspond directly to the schema map. Each element in this list corresponds to an element in the List that `resourceAttributes` comprises.

Each element of the list contains the following attributes

Table 3-62 Attributes of the accountAttribute Resource View Attribute

Attribute	Type	Description
attributeName	String	Specifies the name of the attribute as seen by Identity Manager forms and workflows.
syntax	String	Declares the type of value. Valid values include `string`, `int`, `boolean`, `encrypted`, or `binary`.
name	String	Specifies an auto-generated value. Ignore this value.

Table 3-62 Attributes of the accountAttribute Resource View Attribute

Attribute	Type	Description
mapName	String	Specifies the name of the attribute recognized by the resource adapter.
required	Boolean	If true, this account attribute is required.
audittable	Boolean	If true, this account attribute should always be audited when auditing user events.
multi	Boolean	If true, this account attribute is expected to possibly contains more than one value.
ordered	Boolean	If true, the values of account attribute must be maintained in order.
readonly	Boolean	If true, this account attribute can only be read, and cannot be changed.
writeonly	Boolean	If true, this account attribute can only be written, and cannot be read.

accountId

Specifies the ID by which the resource identifies this account.

accountPolicy

Specifies the policy for account IDs on this resource.

adapterClassName

Identifies the Resource Adapter class to be used to provision to the resource.

allowedApprovers

(Computed read-only value) Lists display names of users who have the permission to perform resource approvals. Edit the UserUIConfig object to specify the user attribute to be used as the display attribute. By default, Identity Manager uses the administrator's `name` attribute.

allowedApproversIds

(Computed read-only value). Computed only if the display attribute used for `allowedApprovers` is something other than `name`.

approvers

Lists the administrator approvers for this resource.

available

Specifies available attributes as indicated in the following table.

Table 3-63 Attributes of the available Attribute of the Resource View

Attributes of available Attribute	Description
available.formFieldNames	Specifies the names of attributes found that start with "*global.*" or "*accounts[<resourcename>].*". These attributes are included in the dropdown list of optional names for the left schema map name.
available.extendedAttributes	Specifies the attributes that are read from the #ID#Configuration:UserExtendedAttributes Configuration object. These attributes are included in the dropdown list of optional names for the left schema map name.

description

Provides a textual description of the resource.

displayName

Specifies the name that Identity Manager displays on the user edit and password pages.

excludedAccountsRule

Specifies the policy for excluding resource accounts from account lists.

facets

Comma-separated list of values that can contain any of these values: `provision`, `activesync`, or `none`. If this string contains `activesync`, then the resource has active sync processing enabled (that is, not disabled). If this string contains `provision`, then Identity Manager displays the basic connection-related resource parameters.

identityTemplate

Specifies the identity template used to generate a user's identity on this resource.

name

Externally identifies the resource. This user-supplied name is unique among resource objects.

organizations

Lists the organizations available to the resource.

passwordPolicy

Specifies the password policy for accounts on this resource.

resourceAttributes

Lists Views. Each element of this List contains the attributes below.

Certain attributes depend upon the type of adapter being configured. At a minimum, these attributes specify how to connect to the resource.

The following attributes uniquely identify the resource object.

Table 3-64

Attribute	Type	Description
name	String	Specifies attribute name.
displayName	String	Specifies I18N-ed label for display.
type	String	Declares the type of value. Valid values include `string`, `int`, `boolean`, `encrypted`, or `binary`.
multivalued	Boolean	If true, this attribute can contain more than one value.
description	String	Provides help text to describe the purpose of the attribute.
noTrim	Boolean	If true, leading and trailing white space will be deleted.
provision	Boolean	If true, this is a standard configuration attribute.
activesync	Boolean	If true, this attribute is needed to configure ActiveSync.
value	Object or ListObject	current values

For example, `<Field name='resourceAttributes[Display Name Attribute].value'>`.

resourcePasswordPolicy

Indicates the resource password policy for resource accounts on this resource.

retryMax

Indicates the maximum number of retries that will be tried on errors attempting to manage objects on a resource.

retryDelay

Specifies the number of seconds between retries.

retryEmail

Identifies the email addresses to send notifications to after reaching the retry notification threshold.

retryEmailThreshold

Specifies the number of retries after which an email is sent.

startupType

Specifies whether the activeSync resource starts up automatically or manually.

syncSource

If set to true, indicates that the resource supports synchronization events.

typeDisplayString

Identifies the display name for the resource type. This should be a message key or ID to be found in the message catalog.

typeString

Specifies the internal name for the resource type.

Resource Object View

Used when modifying resource objects.

All attributes are editable, except <resourceobjectType>.oldAttributes, which are used to calculate attribute-level changes for updates.

In practice, replace <resourceobjectType> with the lowercase name of a resource-specific object type (for example, group, organizationalunit, organization, or role).

Table 3-65 ResourceObject View Attributes

Attribute	Editable?	Data Type	Required?
resourceType	Read/Write	String	
resourceName	Read/Write	String	
resourceId	Read/Write	String	
objectType	Read/Write	String	
objectName	Read/Write	String	
objectId	Read/Write	String	
requestor	Read/Write	String	
attributes	Read/Write	Object	
oldAttributes	Read	Object	
organization	Read/Write	String	
attrstoget	Read/Write	List	
searchContext	Read/Write	Object	
searchAttributes	Read/Write	List	

<resourceobjectType>.resourceType

Lists the Identity Manager resource type name (for example, LDAP, Active Directory).

<resourceobjectType>.resourceName

Lists the Identity Manager resource name.

<resourceobjectType>.resourceId

Lists the Identity Manager resource ID or name.

<resourceobjectType>.objectType

Indicates the resource-specific object type (for example, `Group`).

<resourceobjectType>.objectName

Lists the name of the resource object.

<resourceobjectType>.objectId

Specifies the fully qualified name of the resource object (for example, `dn`).

<resourceobjectType>.requestor

Specifies the ID of the user who is requesting the view.

<resourceobjectType>.attributes

Indicates new or updated resource object attribute name/value pairs (object). This attribute has the following subattribute:

`resourceattrname` -- String used to get or set the value of a specified resource attribute (for example, *<objectType>*`.attributes.cn`, where `cn` is the resource attribute `common name`).

<resourceobjectType>.oldAttributes

Specifies the fetched resource object attribute name/value pairs (object). You cannot edit this value. The view uses this attribute to calculate attribute-level changes for update.

<resourceobjectType>.organization

Identifies the list of organizations of which the resource is a member. This list is used to determine which organizations should have access to the associated audit event record when available for future analysis and reporting.

<resourceobjectType>.attrstoget

List of object-type-specific attributes to return when requesting an object with the `checkoutView` or `getView` methods.

<resourceobjectType>.searchContext

Specifies the context used to search for non-fully qualified names in resources with hierarchical namespaces.

<resourceobjectType>.searchAttributes

Lists the resource object type-specific attribute names that will be used to search within the specified `searchContext` for names of resources with hierarchical namespaces.

<resourceobjectType>.searchTimelimit

Specifies the maximum time spent searching for a name input to a form (if supported by the resource).

Role View

Used to define Identity Manager role objects.

When checked in, this view launches the Manage Role workflow. By default, this workflow simply commits the view changes to the repository, but it also provides hooks for approvals and other customizations.

The following table lists the high-level attributes of this view.

Table 3-66 Role View Attributes

Attribute	Editable?	Data Type	Required
applications	Read/Write	List	No
approvers	Read/Write	List	No
approversRule	Read/Write	String	No
assignedResources	Read/Write	List	No
containedRoles	Read/Write	List	No
description	Read/Write	String	No
disabled	Read/Write	Boolean	No
name	Read/Write	String	Yes
notifications	Read/Write	List	No
notificationsRule	Read/Write	String	No
organizations	Read/Write	List	Yes
owners	Read/Write	List	No
ownersRule	Read/Write	String	No
properties	Read/Write	List	No
resources	Read/Write	List	No
roles	Read/Write	List	No
type	Read/Write	String	No
types	Read	List	No

applications

Specifies the names of locally assigned applications (Resource Groups).

approvers

Specifies the names of the approvers that must approve the assignment of this role to a user.

approversRule

Specifies a rule that returns a list of one or more users who are approvers when this role is assigned and provisioned on a user.

assignedResources

Flattened list of all assigned resources via resources, resource groups, and roles.

Table 3-67 Attributes of assignedResource Attribute (Role View)

Attribute	Editable?	Data Type
`resourceName`	No	String
`name`	No	String
`attributes`	No	Object

resourceName

Identifies the name of the assigned resource.

name

Identifies the resource name or ID (preferably ID).

attributes

Identifies the characteristics of the resource. All subattributes are strings and are editable.

Table 3-68 attribute Options (Role View)

Attribute	Description
`name`	Name of resource attribute
`valueType`	Type of value set for this attribute. Allowed values include Rule, text, or none.
`requirement`	Type of value set by this attribute. Allowed values include Default value, Set to value, Merge with Value, Remove from Value, Merge with Value clear existing, Authoritative set to value, Authoritative merge with value, Authoritative merge with value clear existing.

Table 3-68 attribute Options (Role View)

Attribute	Description
`rule`	Specifies rule name if value type is Rule.
`value`	Specifies value if rule type is Text.

containedRoles

Lists objects that contain information about each contained role.

Table 3-69 Attributes of containedRoles Attribute (Role View)

Attribute	Editable?	Data Type
`name`	No	String
`info`	No	String
`associationType`	Yes	String
`approvalRequired`	Yes	Boolean
`condition`	Yes	Object

name

Specifies the role name.

info

Specifies the following information about the role: description, id, name, noApprovers, and type.

associationType

Specifies whether the association is required, conditional, or optional.

approvalRequired

If `associationType` is optional, this is a Boolean flag that indicates whether approval is required when this role is requested by the user.

condition

If `associationType` is conditional, this is the condition that determines whether this role is assigned to a given user.

description

Describes this role.

disabled

Indicates whether the specified role is disabled. The default value is `false`.

name

Identifies the name of the role. This corresponds to the name of a Role object in the Identity Manager repository.

notifications

Lists the names of administrators that must approve the assignment of this role to a user.

notificationsRule

Specifies a rule that returns a list of one or more users who will be notified when this role is assigned and provisioned on a user.

organizations

Lists organizations of which this role is a member.

owners

Lists one or more users who are specified as approvers for changes to this role.

ownersRule

Specifies a rule that returns a list of one or more users who are approvers for changes to this role.

properties

Identifies the user-defined properties that are stored on this role.

resources

Specifies the names of locally assigned resources.

roles

Specifies the names of locally assigned roles.

type

Identifies this role's type as defined in the Role Configuration object.

types

Cached type information from the Role Configuration object for use by the view (read-only).

Task Schedule View

Use to create and modify TaskSchedule objects.

This view contains the following attributes:

Table 3-70 Task Schedule View Attributes

Name	Editable?	Data Type	Required?
scheduler	Read/Write	String	
task	Read/Write	Boolean	

scheduler

Contains attributes that are related to the scheduler itself, which are common to all scheduled tasks. The attributes are:

Table 3-71 Attributes of scheduler Attribute (Task Schedule View)

Name	Editable?	Data Type	Required?
name	Read/Write	String	No
id	Read	String	No
definition	Read/Write	String	No
template	Read/Write	String	No
taskOrganization	Read/Write	String	No
taskName	Read/Write	String	No
description	Read/Write	String	No
disabled	Read/Write	Boolean	No
skipMissed	Read/Write	Boolean	No
start	Read/Write	Date	No
repeatCount	Read/Write	Int	No
repeatUnit	Read/Write	String	No
resultOption	Read/Write	String	No
allowMultiple	Read/Write	Boolean	No

NOTE Typically, you supply a value for either `scheduler.definition` or `scheduler.template`. If you do not specify either value, Identity Manager creates a TaskSchedule object that you can later edit to specify the definition or template.

name

Specifies the name of an existing TaskSchedule object or the desired name for a new TaskSchedule object. It is not required, but if not specified, the system will generate a random identifier.

id

Uniquely identifies the existing TaskSchedule object.

definition

Defines the name a TaskDefinition object to be scheduled.

template

Specifies the name of a TaskTemplate object to be scheduled. If both `definition` and `template` are specified, `template` has priority.

taskOrganization

Contains the name of the organization in which the TaskInstance will be placed when the schedule task is launched.

taskName

Specifies the name of the TaskInstance that is created when the schedule task is launched.

description

Contains descriptive text that will be saved in the TaskInstance that will be created when the schedule task is launched. The description will appear in the task tables in the product interface.

disabled

Controls whether the task scheduler will process the TaskSchedule object. The scheduler ignores TaskSchedule's whose disable attribute is true. You can use this to temporarily stop running a schedule task, without having to delete and recreate the TaskSchedule object.

start

Indicates the date and time at which to launch the task.

repeatCount

Combined with `repeatUnit`, determines how frequently tasks will be run. If repeatCount is zero or not specified a scheduled task will only run once. If repeatCount is a positive number, the task will be run more than once at the interval specified by repeatUnit.

repeatUnit

Defines the interval of time between running tasks that have a positive `repeatCount` value. Valid values include: `second`, `minute`, `hour`, `day`, `week`, `month`. For example, to schedule a task to run once a week for a year set `repeatUnit` to week, `repeatCount` to 52, and `start` to the first day that the task is to run.

resultOption

Specifies what the scheduler will do if a TaskInstance with the desired name already exists when the scheduled task is run. The possible values are: `wait`, `delete`, `rename`, and `terminate`.

wait

Indicates whether the scheduler should run the task again or wait for another repetition. This attribute is only meaningful if you have set `repeatCount` and `repeatUnit`.

delete

Tells the scheduler to delete the existing TaskInstance, if it has finished.

rename

Indicates that the scheduler should rename the existing TaskInstance, if it has finished.

skipMissed

Indicates whether Identity Manager attempts to immediately make up a missed schedule time (`false`) or simply wait until the next scheduled time (`true`).

When set to `false`, Identity Manager immediately attempts to make up a missed schedule time. When set to true, Identity Manager instead waits until the next scheduled time. The default is `false`.

terminate

Similar to delete, but will also terminate the existing task, if it is still running.

allowMultiple

Controls whether more than one instance of the same task definition or task template are allowed to run. If `true` (the default), the scheduler will always create a new instance of the task. If `false`, the scheduler will not create a new instance if there is one already running.

task

Contains task-specific attributes. Each task defines its own attributes, and the task's form should reference them relative to the `task` namespace.

Unlock View

Used to unlock accounts for those resources that support native account locking. This view presents and selects the list of resource accounts to be unlocked.

NOTE Use the Unlock view instead of the Disable view for accounts whose resources support native account locking.

Contains the following high-level attributes:

Table 3-72 Unlock View Attributes

Name	Editable?	Data Type	Required?
id	Read	String	Yes
selectAll	Read/Write	Boolean	No
currentResourceAccounts	Read	List (objects)	No
tobeCreatedResourceAccounts	Read	List (objects)	No
tobeDeletedResourceAccounts	Read	List (objects)	No
fetchAccounts	Read/Write	Boolean	
fetchAccountResources	Read/Write	List	

id

Specifies the account ID of the Identity Manager user whose passwords are being unlocked.

selectAll

Controls whether all password are unlocked.

currentResourceAccounts

Represents the set of accounts that are currently being managed by Identity Manager (including the Identity Manager account itself).

tobeCreatedResourceAccounts

Represents the accounts that are assigned to this Identity Manager user but which have not been created. Passwords cannot be unlocked on accounts that have not yet been created.

tobeDeletedResourceAccounts

Represents the accounts that have been created but are no longer assigned to this user. Passwords cannot be changed on accounts that are going to be deleted.

All three account lists contain objects that describe the state of the account on each resource and allow you to individually select accounts.

Both resource account list are indexed by resource name, and will contain objects that describe the resources on which this user has accounts.

Table 3-73 tobeDeletedResourceAccounts Attributes (Unlock View)

Name	Editable?	Data Type
`selected`	Read/Write	Boolean
`name`	Read/Write	String
`type`	Read/Write	String
`accountId`	Read/Write	String
exists	Read/Write	Boolean
`locked`	Read/Write	Boolean
`authenticator`	Read/Write	Boolean

selected

Identifies that this resource has been selected to be unlocked.

name

Specifies the name of resource. This corresponds to the name of a `resource` object in the Identity Manager repository

type

Identifies the type of resource, such as Solaris. You can determine the resource type names by bringing up the resource list from the Identity Manager Administrator interface. The **Type** column on this page contains the names of the type of currently defined resources. The options list next to **New Resource** also contains the names of the resource adapters that are currently installed.

accountId

Specifies the identity of the account on this resource, if one has been created.

exists

Indicates whether the account already exists on the resource (only in `currentResourceAccounts`).

locked

Indicates whether the account is currently locked or not (unlocked). The value of `exists` indicates whether the account already exists on the resource or not (only in `currentResourceAccounts`).

authenticator

If `true`, indicates that this resource serves as the pass-through authentication resource for Identity Manager.

fetchAccounts

Causes the view to include account attributes for the resources assigned to the user.

See *Setting View Options in Forms* in this chapter for more information.

fetchAccountResources

Lists resource names from which to fetch. If unspecified, Identity Manager uses all.

See *Setting View Options in Forms* in this chapter for more information.

User Entitlement View

Use to create and modify UserEntitlement objects.

This view has the following top-level attributes:

Table 3-74 Top-Level Attributes of User Entitlement View

Name	Editable?	Type	Required?
`name`		String	Yes
`status`		String	Yes
`user`		String	Yes
`userId`		String	Yes
attestorHint		String	No
userView		GenericObject	Yes
reviewInstanceId		String	Yes
reviewStartDate		String	Yes
scanId		String	Yes
scanInstanceId		String	Yes
approvalWorkflowName		String	Yes
organizationId		String	Yes
attestorComments.name		String	No
attestorComments.attestor		String	No
attestorComments.time		String	No
attestorComments.timestamp		String	No
attestorComments.status			No

name

Identifies the User Entitlement (by a unique identifier).

status

Specifies the state of User Entitlement object. Valid states include PENDING, ACCEPTED, REJECTED, REMEDIATING, CANCELLED.

user

Identifies the name of the associated WSUser for this entitlement.

userId

Specifies the ID of the associated WSUser.

attestorHint

Displays the (String) hint to the attestor that is provided by the Review Determination Rule. This hints acts as “advice” from the rule to the attestor.

userView

Contains the User view that is captured by User Entitlement scanner. This view contains zero or more resource accounts depending on the configuration of the Access Scan object.

reviewInstanceId

Specifies the ID of the PAR Task instance.

reviewStartDate

Indicates the (String) start date of the PAR task (in canonical format).

scanId

Specifies the ID of AccessScan Task definition.

scanInstanceId

Specifies the ID of AccessScan Task instance.

approvalWorkflowName

Identifies the name of workflow to be run for approval. This value comes from the Access Scan Task definition.

organizationId

Specifies the ID of the WSUser's organization at the time of the scan.

attestorComments

Lists attestation records for the entitlement. Each attestation record indicates an action or statement made about the entitlement, including approval, rejection, and rescan.

attestorComments[timestamp].name

Timestamp used to identify this element in the list.

attestorComments[timestamp].attestor

Identifies the WSUser name of the attestor making the comment on the entitlement.

attestorComments[timestamp].time

Specifies the time at which the attestor attested this record. May differ from the timestamp.

attestorComments[timestamp].status

Indicates the status assigned by the attestor. This can be any string, but typically is a string that indicates the action taken by the attestor -- for example, approve, reject, rescan, remediate.

attestorComments[name].comment

Contains comments added by attestor.

WorkItem View

Used to view and modify WorkItem objects in the repository.

A *WorkItem* object is created whenever a manual action that is defined in a workflow process is activated. The WorkItem view contains a few attributes that describe the WorkItem object itself, as well as values of selected workflow variables copied from the workflow task.

Identity Manager returns information about the work items in the Work Item view under the `workItem.related` attribute.

Returning Information about All Active Work Items

This view provides the ability to return information about all work items that are currently active in a workflow task. By default, Identity Manager returns information about only a specified work item, not related work items. However, you can use other options to filter work items, and the attributes of the related work items you want to display.

Use the following three form properties to change the default behavior of this view:

Table 3-75

If you want to ...	Use this form property
Return all related items by default...	`includeRelatedItems` form property
Request additional attributes to be returned...	`relatedItemAttributes` form property
Limit which items are returned...	`relatedItemFilter` form property

Example: Using the includeRelatedItems Form Property

By default, Identity Manager uses the Approval form to display work items. Edit this form by adding the `includeRelatedItems` element to include related work items:

```
<Properties>
```

```
   <Property name='includeRelatedItems' value='true'/>
</Properties>
```

Example: Using the relatedItemAttributes Form Property

You can also request additional attributes with the `relatedItemAttributes` option. This option can be a CSV string of names or a list of names. You can request the following standard attributes:

- `request`
- `requester`
- `description`
- `activityName`

If you request an attribute name that is not on this list, Identity Manager assumes that it is an arbitrary workflow variable, and the value will be returned if it exists in the work item. Common variables found in the standard workflows include:

- `accountId`
- `objectType`
- `objectName`
- `diagramLabel`

Example: Using the includeRelatedItems Form Property

To include the `request` and `description` attributes, add these properties to the Approval form:

```
<Properties>
   <Property name='includeRelatedItems' value='true'/>
   <Property name='relatedItemAttributes' value='request,description'/>
</Properties>
```

Example: Using relatedItemFilter Form Property

You can specify the following filter attributes.

Table 3-76 relatedItemFilter Option Values

relatedItemFilter Option Values	Results of Filtering
`itemType`	Only work items with a matching itemType are returned
`activityName`	Only work items created from the same activity are returned
`request`	Only work items with the same user defined request string are returned
`locked`	Only work items that are currently locked for editing are returned

If more than one filter attribute is on the list, they will be logically AND'ed together. For example, to return only work items with the same request string that are current locked, add this property to the Approval form:

```
<Properties>
   <Property name='includeRelatedItems' value='true'/>
     <Property
name='relatedItemAttributes'value='request,description'/>
     <Property name='relatedItemFilter' value='request,locked'/>
</Properties>
```

An example field that displays a table of information about the related work items was added to the Approval Library form library, the field name is Related Approvers. You can reference this field from the standard Approval form as follows:

```
<FieldRef name='Related Approvers'/>
```

Changing the Repository Lock Timeout for Work Items

The default time-out interval for locking work items in the repository is five minutes. You can change this value by adding the following element to the `RelocatedTypes` element of the RepositoryConfiguration Configuration object:

```
<TypeDataStore typeName='WorkItem' lockTimeoutMillis='10000'/>
```

Top-Level Attributes

The following table lists the top-level WorkItem view attributes.

Table 3-77 WorkItem View Attributes

Attribute	Editable?	Data Type	Required?
id	Read	String	
name	Read	String	
taskId	Read	String	
taskName	Read	String	
processName	Read	String	
activityName	Read	String	
description	Read/Write	String	
owner	Read/Write	String	
complete	Read/Write	Boolean	
variables			
workItem			

id

Identifies the repository ID of the WorkItem object. Typically generated by Identity Manager and not displayed.

name

Identifies the repository name of the WorkItem object.

taskId

Identifies the repository ID of the workflow TaskInstance. This attribute is used by the system to correlate the work item with the workflow task and must not be changed.

taskName

Identifies the repository name of the workflow TaskInstance. This name is typically set to an informative value and can be displayed. Do not modify it. A typical example task name for a user update would be `Updating User jdoe`.

processName

Identifies the name of the workflow process definition that contains the manual action.

activityName

Specifies the name of the workflow activity that contains the manual action.

description

Contains a textual description of the work item. Its contents are defined by the workflow process definition. The description is typically displayed in tables that summarize the work items for a user, and is often displayed in a work item form.

owner

Identifies the name of the current Identity Manager administrator or user that created the workflow process. This attribute is typically the name of an Identity Manager user. If this work item is assigned to an anonymous user, the name will have the prefix **Temp:**.

complete

Set to `true` when the manual action has completed and the workflow is to be resumed. Assignment of the complete attribute must be performed in the Work Item form.

You can edit this Boolean value.

variables

Contains another object whose attributes contain copies of variables from the workflow task. By default, every workflow variable that is in scope when the manual action is activated is copied into the work item. This can be controlled with the Exposed Variables and Editable Variables options in the process definition. Most work item forms display information found under the `variables` attribute. See the section *Using the variables Attribute* later in this chapter for more information on using this attribute.

workItem

Specifies additional information about the work item. Contains the following attributes:

views

Contains a list of workflow variables whose values are views. The system uses this attribute to cause view-specific refresh operations when the work item view is refreshed.

Do not change this value.

related

Contains a list of attributes that describe the specified work item.

Table 3-78 Subattributes of the workItem.related Attribute (Work Item View

Attribute	Description
`name`	Specifies the repository ID of the work item.
`owner`	Identifies the owner of the item.
`locked`	Indicates whether the work item is being edited. A value of `true` indicates that the work item is currently being edited.
`complete`	Specifies whether the work item has completed. A value of `true` indicates that the work item completed.
`itemType`	Identifies item type as defined by the process. The default is `approval`.

request

Succinctly describes the purpose of the work item. This description is typically shorter than the value of the `description` attribute and is often displayed in summary tables.

requester

Identifies the user that initiated the approval.

ignoreTimeOut

Indicates whether the time out should be ignored. A value of `true` (assigned by the system) indicates that this is a read-only work item that may timeout while being viewed. This is a signal to the system that a check-in failure of the Work Item view should be ignored if the work item no longer exists, rather than displaying an error message. This can be useful for work items that are intended only for status messages that time out immediately so the workflow can continue while the user views the messages.

Do not change this value.

Using the variables Attribute

When writing a work item form, the most common attributes to reference are `complete` and `variables`. The complete attribute must be set to the value `true` in order for the workflow to be resumed. It is typically set by a hidden field in response to pressing button fields with labels such as **Approve** and **Reject**.

The variables attribute contains an object whose values are copies of variables from the workflow task. One of the most common workflow variables used in work items is user, which contains a user view. For example, to reference the global.email attribute from a work item form, use the following path expression:

```
variables.user.global.email
```

This differs from attribute paths used in a standard user form. First, the entire view is stored in a workflow variable named user, which results in the user. prefix being required in the attribute path. Next, the workflow variables are stored under the variables attribute in the Work Item view, which results in an additional variables. prefix being required in the attribute path.

Because of this nesting of the user view attributes, you cannot use a standard user form with the Work Item view without modification. However, you can define a work item form that references the user form with the base context option.

Example

```
<Form name='WorkItemForm'>
   <Include>
      <ObjectRef Type='UserForm' name='Default User Form'/>
   </Include>
   <FormRef name='Default User Form' baseContext='variables.user'/>
</Form>
```

NOTE Although in practice the work item form requires additional fields for buttons such as Approve and Reject, you may not want everything displayed by Default User Form displayed in the work item form. Typically, you can factor out the fields in the user form into a form library that can be referenced by both the user forms and the work item forms.

WorkItem List View

Used to view information about collections of work items in the repository and to perform operations on multiple work items at a time.

This view handler gathers information about:

- all work items assigned to a selected user
- users whose work items can be viewed
- users to whom the work items can be forwarded

The view is used in the Approvals page of the Identity Manager Administrator Interface. The default form used with this view is named Work Item List.

The following table lists the top-level WorkItem List view attributes.

Table 3-79 WorkItem View Attributes

Attribute	Editable?	Data Type
authType	Read/Write	String
userId	Read	String
user	Read/Write	String
self	Read	Boolean
forwardedUser	Read	Boolean
itemType	Read/Write	String
users	Read	List
userIds	Read	String
forwardingApproverStyle	Read	
forwardingUsers	Read	List
forwardingUserIds	Read	List
workItems	Read/Write	String
selectedWorkItems	Read/Write	String
forwardTo	Read/Write	Boolean
forwardToNow	Read/Write	String
variables	Read/Write	String
action	Read/Write	Boolean
confirm	Read/Write	Boolean

authType

Specifies access to work items by type. For example, there is a built-in authorization type called EndUserRule. All end-users implicitly get access to all rules tagged with the EndUserRule authorization type.

userId

Specifies the name of the Identity Manager user whose work items are contained in the workItem list. Initially, this value is the name of the current session user. The value can be null to indicate that the work items for all controlled users with approver rights should be displayed. This is always the Identity Manager user name, never a display name.

The form must not be modify this value. To change users, set the `user` attribute.

user

Specifies the display name of the Identity Manager user whose work items are listed. This value is the same as `userId` if display names are not used. The form can modify this value, which causes the system to recalculate the work item list during refresh. A null value indicates that all work items are being displayed.

self

Set to true if the `userId` is the same as the current session user.

forwardedUser

When set, indicates that the user named by `userId` has elected to have work items forwarded to another user. The other user is identified by its display name.

users

Lists the display names of Identity Manager users that the current user controls and which have work item capabilities. This value is typically used to build an user select box. If a custom form wants to compute the user list in a different way, you can specify the view option CustomUserLists as either a view option or form property.

userIds

Typically null. If you are configured to use alternate display names, then the users list contains display names, and this list contains the true repository names.

forwardingUsers

Lists the display names of Identity Manager users to which the current user can forward work items. This value depends on the value of the `ForwardingApproverStyle` attribute, which defaults to `peers`.

itemType

When set, the work items in the list will be filtered to contain only those whose item type matches this value. This gives the WorkItemList view the ability to filter the item list based on the work item type.

forwardingUserIds

Typically null. If you are configured to use alternate display names, then the `forwardingUsers` list will have display names, and this list will have the true repository names.

workItems

Lists the objects that contain information about the work items for the selected user(s). The object names are the repository IDs of the work items.

workItems[].owner

Specifies the display name of the owner. Set only if `user` is null and all work items are displayed.

workItems[].request

Supplies a brief description of the object being requested. This value is computed by the WorkItemRequest expression of the manual action in the workflow process.

workItems[].requester

Identifies the display name of the user that made the request.

workItems[].description

Provides a more detailed description of the work item. The value is computed by the WorkItemDescription expression of the manual action in the workflow process. The description is typically displayed in tables that summarize the work items for a user, and is often displayed in a work item form.

workItems[].selected

Individual item selection flag. An alternative to `selectedWorkItems`.

selectedWorkItems

Lists the work item IDs that represent the items to be processed by the next action. An alternative to setting the `selected` attribute inside the work item object, which is easier for SortingTable components. If both this attribute and individual select flags are set, the value of this attribute takes precedence.

forwardTo

Identifies the name of an Identity Manager user to which all selected work items will be forwarded when the `action` attribute is set to `Forward`.

forwardToNow

Similar to `forwardTo`, but is also an `action` attribute. It copies its value to `forwardTo`, set `action=Forward` and process the refresh as if `forwardTo` and `action` were set independently. Use this attribute if you want to have the form process the forwarding immediately after a user is selected from a form component. If you would rather have forwarding controlled with a button, then have the form component set the `forwardTo` attribute and have the button post an `action` value of `Forward`.

action

(Boolean) When non-null, initiates an operation on the selected work items.

Valid values include:

- approve
- reject
- forward
- refresh

If the NoConfirm option is set, the action is processed immediately. Otherwise, Identity Manager waits for the `confirm` attribute to be set to `true`. The form is expected to define its own confirmation page rendering.

confirm

(Boolean) Indicates that the operation specified in the `action` attribute can be performed.

Using the variables Attribute

When editing an individual work item, the form can set work item variables, such as `comments`, to pass additional information about the approval or rejection into the workflow process for auditing.

You can also set arbitrary work item variables when performing actions in the WorkItemList view. The value of the attribute `variables` can be set to an object whose attributes will be copied into the work item when it is approved or rejected. For example, if the variables object contains an attribute named `comments`, the same comments will be saved with every selected work item.

```
<Form name='variables.comments'>
   <Default>
<concat>
       <s>Approval performed on </s>
<invoke class='com.waveset.util.Util' name='dateToString'>
         <new class='java.util.Date'/>
         </invoke>
     </concat>
   </Default>
</Form>
```

NOTE Although in practice the work item form requires additional fields for buttons such as Approve and Reject, you may not want everything displayed by Default User Form displayed in the work item form. Typically, you can factor out the fields in the user form into a form library that can be referenced by both the user forms and the work item forms.

View Options

You can specify the following options when the view is created or refreshed to control the behavior of the WorkItemList viewer.

userId

Identifies the name of the initial user whose work items are to be displayed. Can be used to override the default, which is the current session user.

CustomUserLists

When set to `true`, indicates the form will generate both the `users` and `forwardingUsers` lists in a custom way and that the view handler should not generate them. Generating these lists can be time-consuming if there are many approvers in the system. If the form does not intend to use the default `users` and `forwardingUsers` lists, enable this option.

ForwardingApproverStyle

Specifies the types of administrators whose names will be available in the Forward to list. The value of this attribute defaults to `peers`. Can be set to one of these values:

Table 3-80 ForwardingApproverStyle View Option Values

Option Value	Description
`peers`	Specifies administrators at the same organization level as the current user or above
`controlled`	Specifies administrators in organizations that are controlled by the current user
`all`	Specifies both controlled and peers

You can set this and other view options as form properties:

```
<Form...>
   <Properties>
      <Property name='ForwardingApproverStyle" value='peers'/>
   </Properties>
 ...
</Form>
```

NoUserListCache

When `true`, indicates that the view handler should not cache the `users` and `forwardingUsers` lists but instead recalculate them every time the form is refreshed. Since calculating the user lists can be expensive, it is generally preferred to cache them and refresh only when explicitly instructed by setting the `action` attribute to Refresh.

UserDisplayName

Can be set to the name of an extended user attribute whose value is to be used instead of the repository name in the user lists. This can also be specified in the UserUIConfig object, but it may be more convenient to set in the form.

NoUserDisplayName

When `true`, indicates that display names should not be used even if one is specified in the UserUIConfig object. You can set this option in a form to selectively override the UserUIConfig setting.

NoConfirm

When `true`, indicates that the action specified with the `action` attribute should be executed immediately without confirmation.

Setting View Options in Forms

View options can be conveniently set in some forms. To set view options in a form, follow these steps. The following procedure uses the WorkItem List view as an example.

1. Copy the form into the Identity Manager IDE or the XML editor of choice.
2. Change the form name.
3. Register it in the System Configuration object under the `form.workItemList` attribute.

In the custom form, you can then specify view options as properties of the form as indicated in the following example.

Example

```
<Form>
 <Properties>
 <Property name='CustomUserLists' value='true'/>
</Properties>
 ...
</Form>
```

Deferred Attributes

A *deferred attribute* is an attribute that derives its value from an attribute value on a different account. You declare the deferred attribute in a view (and the WSUser model), and the provisioning engine performs this substitution immediately before calling the adapter.

If the deferred attribute derives its value from another resource's GUID attribute, the source adapter does not need to take action. However, if the source attribute is not the GUID, the adapter must return the attribute in the ResourceInfo._resultsAttributes map as a side effect of the realCreate operation. If the adapter does not return the attribute, the provisioning engine will fetch the account to get the value. This is less efficient than modifying the adapter to return the value.

When to Use Deferred Attributes

Use deferred attributes when creating new accounts to specify that the value of an account attribute is to be derived from the value of an attribute on a different account that will not be known until the source account has been created. One common example is to set an attribute to the value of the generated unique identifier.

Using Deferred Attributes

There are two main steps to defining a deferred attribute:

1. Ensure that the account is created on the source resource before the second account is created. Do this by creating an ordered Resource Group that contains both resources and assigning the Resource Group to the user.
2. Set the special attributes in the User view for the accounts that are to be created as indicated by the following sample scenario. Each deferred attribute requires two view attributes: one that identifies the source account, and one that identifies the source attribute. Set these using paths of the following form:

   `accounts[<resource>].deferredAttributes.<attname>.resource`

   `accounts[<resource>].deferredAttributes.<attname>.attribute`

   where `<resource>` would be replaced with an actual resource name and `<attname>` replaced with an actual attribute name.

For example, assume a scenario in which the following two resources are created: 1) a resource named LDAP that generates a `uid` attribute when an account is created; 2)a resource named HR, which contains a `directoryid` attribute named `directoryid`, whose value is to be the same as `uid` in the LDAP resource.

The following form fields set the necessary view attributes to define this association.

```
<Field name='accounts[HR].deferredAttributes.directoryid.resource'>
   <Expansion><s>LDAP</s></Expansion>
</Field>
<Field name='accounts[HR].deferredAttributes.directoryid
   <Expansion><s>uid</s></Expansion>
</Field>
```

Extending Views

Some views that set specific resource account attributes such as the password or the enable flag allow you to set additional account attributes. For security, however, these extended attributes must be registered.

Attribute Registration

Attributes can be registered in one of two locations:

Table 3-81 Locations for Attribute Registration

Location	Register attributes here if...
`AccountAttributeType` definition in the resource	... the attributes you want to update are specific to a particular resource, rather than to all resources of that type.
System Configuration Object	...you want to make global registrations for all resources of a particular type. These registrations must be done in XML format.

You can register different attributes for different views. For example, you can register the `lock` attribute for the Password view and the `firstname` attribute for the Rename view.

Global Registration

To make global registrations (that is, registrations that apply to all resources), add an attribute in the System Configuration object with this path:

`updatableAttributes.ViewName.ResourceTypeName`

where *ViewName* is one of Password, Reset, Enable, Disable, Rename, or Delete, and *ResourceTypeName* is the name of the resource type. The type name `all` is reserved for registrations that apply to all resources.

The value of this attribute must be a List of Strings. The strings are names of the attributes you want to update.

The following example registers the attribute named `delete before action` in the Deprovision view for all resources.

```
<Attribute name='updatableAttributes'>
   <Object>
      <Attribute name='Delete'>
         <Object>
            <Attribute name='all'>
               <List>
                  <String>delete before action</String>
               </List>
            </Attribute>
         </Object>
      </Attribute>
      <Attribute name='Enable'>
         <Object>
            <Attribute name='all'>
               <List>
                  <String>enable before action</String>
               </List>
            </Attribute>
         </Object>
      </Attribute>
   </Object>
</Attribute>
```

Resource-Specific Registration

To make resource-specific registrations, modify the resource object from the Identity Manager Debug page and insert a `<Views>` subelement in the `AccountAttributeType` element. `<Views>` must contain a list of strings whose values are the names of the views in which this attribute can be updated.

```
<AccountAttributeType name='lastname' mapName='sn'mapType='string'>
   <Views>
      <String>Rename</String>
   </Views>
</AccountAttributeType>
```

In the view, attributes you want to modify are placed within this object:

`resourceAccounts.currentResourceAccounts[ResourceTypeName].attributes`

```
<Field name=
'resourceAccounts.currentResourceAccounts[OS400ResourceName].attributes
.delete before action' hidden='true'>
   <Expansion>
      <s>os400BeforeDeleteAction</s>
   </Expansion>
</Field>
```

Chapter 4

XPRESS Language

This chapter introduces the basic features of XPRESS, an XML-based expression and scripting language. Statements written in this language, called *expressions*, are used throughout Identity Manager to add data transformation capabilities to forms and to incorporate state transition logic within objects such as workflow and forms.

Topics in this Chapter

Read this chapter to understand these basic topics:

- Essential features of the XPRESS language, including its use of prefix notation and XML syntax
- Examples of typical expressions within Identity Manager
- Library of functions that ships with Identity Manager
- Possible data types that functions return

About the XPRESS Language

XPRESS is a functional language that uses syntax based on XML. Every statement in the language is a function call that takes zero or more arguments and returns a value. Identity Manager provides a rich set of built-in functions, and you can also define new functions. XPRESS also supports the invocation of methods on any Java class and the evaluation of JavaScript within an expression.

Prefix Notation

The XPRESS language makes no distinction between a function call and what languages such as C refer to as an expression operator. This results in a syntactical style known as prefix notation. Prefix notation differs from the more common infix notation in that the operator of an expression is written first, followed by the operands. For example, consider the following simple logical expression written in C using infix notation:

```
x == 42
```

If C used prefix notation, the previous statement would be written:

```
== x 42
```

If C provided no expression operators and instead supplied only functions, the statement could be written as follows:

```
equals(x, 42)
```

Prefix notation is easily understood if you think in terms of calling functions rather than writing expressions.

XML Syntax and Example

XPRESS uses an XML syntax that is easy to parse and manipulate and can be embedded naturally in other XML vocabularies used within Identity Manager. The names of the XML elements are the names of functions to be called. Nested elements are the arguments to the function. In addition, there are beginning and end tags for each element (in this case, `<add></add>`).

Example

```
<add> <ref>counter</ref> <i>10</i> </add>
```

In the preceding example, the `<add>` element represents a call to the function named `add`. This function is passed two arguments:

- *first argument* – value is determined by calling a function named `ref`. The argument to the `ref` function is a literal string that is assumed to be the name of a variable. The value returned by the `ref` function is the current value of the variable *counter*.
- *second argument* – value is determined by calling a function named `i`. The argument to the `i` function is a literal string that is an integer. The value that the `i` function returns is the integer 10.

The value returned by the `add` function will then be the result of adding the integer 10 to the current value of the variable *counter*. Every function call either returns a value or performs an operation on one of its arguments. For example, if the `ref` call returns the value of the counter, then the `<i>` call returns the integer `10`, and the `<add>` call returns the addition of the two calls.

Another example is the classic `Hello World` program, which is written in XPRESS as follows:

```
<print><s>Hello World!</s></print>
```

Integration with Identity Manager

Although XPRESS can be used with a standalone interpreter, it is typically embedded within an application that wants to use XPRESS statements to control or customize their behavior. This application is called the *host application*. Two of the more important host applications within the Identity Manager system are workflow and forms.

The host application makes calls to the XPRESS interpreter and supplies services to the interpreter. One of the more important services that the host application provides is the resolution of *external variable references*. Expressions often reference variables that are not defined within the expression, and the host application must then provide the values of these variables. In the case of the workflow host application, an expression can reference any variable defined within the workflow process. In the forms host application, an expression can reference the value of any form field or `defvar` whose value is set before the expression is evaluated.

Why Use Expressions?

Expressions are used primarily for the following tasks:

- **Customizing the User Interface and Administrator Interface forms**. Forms use XPRESS to control the visibility of fields and to transform the data to be displayed.
- **Defining flow of control in workflow**. Workflow uses XPRESS to define *transition conditions,* which determine the order in which steps in the workflow process are performed.
- **Implementing workflow actions**. Workflow actions can be implemented using XPRESS. Action expressions can perform simple calculations, or call out to Java classes or JavaScript to perform a complex operation.

For information on using expressions in workflow scripts or editing forms, see Chapter 1, “Workflow” on page 15.

Working with Expressions

This section presents examples of some of the more common usages of expressions within Identity Manager, in particular:

- Controlling field visibility
- Calculating default field values
- Deriving field values
- Generating field values
- Workflow transition conditions
- Workflow actions
- Invoking Java methods from workflow actions

Controlling Field Visibility

A common form design problem requires suppressing the display of certain fields until a particular condition is met. For example, certain resource-specific fields are relevant only when a particular resource is assigned to the user. These fields should be visible only when the resource is assigned. Otherwise, these fields should be hidden from view and not evaluated. The following example illustrates a field definition that uses an expression within the `<Disable>` element to control the visibility of such a field.

```
<Field name='HomeDirectory'>
   <Display class='Text'/>
      <Property name='title' value='HomeDirectory'/>
   </Display>

   <Disable>
      <not>
         <contains>
            <ref>accountInfo.typeNames</ref>
            <s>Solaris</s>
         </contains>
      </not>
   </Disable>
</Field>
```

The <Disable> element is part of the Form XML language. The contents of the <Disable> element can be any expression in the XPRESS language. In this case, the expression is testing to see if the string Solaris appears in a list stored in the external variable named accountInfo.typeNames. With forms, this variable contains a list of all resource types currently assigned to the user.

When the form is processed for display, the expression in the <Disable> element is evaluated. If it returns true, this field is not displayed.

The values null and 0 are logically false. Non-null or non-zero fields are logically true. This means that the sting represented with the expression <s>false</s> is logically true because it is non-null.

Field values can be calculated by XPRESS using one of three elements specified in the field declaration: Derivation, Default, and Expansion.

Calculating Default Field Values

Field values can be calculated from other fields or simply set to an initial value using the <Default> element. The <Default> element is typically used to initialize an editable field and is evaluated only if the field does not already have a value assigned to it. The <Default> element is often used to calculate an account ID based on the first and last name of the user. The following example shows a field definition that uses string manipulation expressions to calculate a default account ID consisting of the first letter of the user's first name concatenated with the user's last name.

```
<Field name='waveset.accountId'>
   <Display class='Text'/>
      <Property name='title' value='AccountID'/>
   </Display>
   <Default>
      <concat>
         <substr>
            <ref>accounts[AD].firstname</ref>
            <i>0</i>
            <i>1</i>
         </substr>
         <ref>accounts[AD].lastname</ref>
      </concat>
   </Default>
</Field>
```

The `<Default>` element is part of the Form XML language. This element can contain either an XPRESS expression or elements in another language called *XML Object*. (For more information on XML Object language, see the chapter titled XML Object Language)

When this field is processed, the system checks to see if a value already exists for the `waveset.accountId` attribute. If no value exists, it evaluates the expression in the `<Default>` element. In this case, a value is calculated by concatenating the first letter of the first name with the last name.

You may need to make sure that `firstname` and `lastname` fields have values, as demonstrated by the following example:

```
<cond>
  <and>
    <notnull><ref>accounts[AD].firstname</ref></notnull>
    <notnull><ref>accounts[AD].lastname</ref></notnull>
  </and>
  <concat>
    <substr>
         <ref>accounts[AD].firstname</ref>
         <i>0</i>
         <i>1</i>
     </substr>
    <ref>accounts[AD].lastname</ref>
  </concat>
</cond>
```

The preceding code is structured as an if-then statement in other programming languages. This `cond` expression has two arguments:

- conditional expression
- then expression

First, the conditional expression is evaluated. If the result of this expression is logically true, the value of `cond` will be the value of the then expression. If the result of the conditional expression is false, the value of `cond` will be `null`.

In this example, the `cond` statement ensures that values exist for two account attributes before using them to calculate `accountID`. The `Default` expression will continue to be evaluated each time the form is refreshed or saved until the prerequisites are finally set or until the user provides a value in the field. The `Default` expression will not be evaluated if the associated field contains a non-null value.

Deriving Field Values

A `<Derivation>` expression is similar to a `<Default>` expression except that it always calculates a value for the field, even if the field already has a non-null value. This is typically used to display a field whose value is a permutation of another field's value. This is a valuable design feature if the resource attribute value is encoded and would not be obvious to the user.

The following example shows a field definition that uses conditional logic to map one set of values into another set.

```
<Field name='location' prompt='Location'>
   <Display class='Text'/>
      <Derivation>
         <switch>
            <ref>accounts[Oracle].locCode</ref>
            <case>
               <s>AUS</s>
               <s>Austin</s>
            </case>
            <case>
               <s>HOU</s>
               <s>Houston</s>
            </case>
            <case>
               <s>DAL</s>
               <s>Dallas</s>
            </case>
            <case default='true'>
               <s>unknown</s>
            </case>
         </switch>
   </Derivation>
</Field>
```

The `<Derivation>` element is part of the Form XML language that can contain an expression. When this field is processed, the expression in the `<Derivation>` element is evaluated to determine the value to be displayed for this field.

In the preceding example, the value of the resource account attribute `accounts[Oracle].locCode` is compared to the first value in each case expression. If a match is found, the result of the `switch` expression is the second value in the matching case expression.If no matches are found, the result of the `switch` is the value within the default case.

Generating Field Values

In certain forms, you might want to first display a set of abstract derived fields to the user, then generate a different set of concrete resource account attribute values when the form is submitted. This is known as *form expansion*. An `<Expansion>` element is typically used in hidden fields that depend on editable fields in the form. One purpose of the `<Expansion>` element is to convert data that is familiar and readable to an end-user into data that is recognized by a resource. For example, a user can see a manager's full name in the form, but the system receives a unique ID that it recognizes as belonging to a manager.

The following example shows a field definition that uses conditional logic to convert the value derived for the `location` field in the previous example back into a three-letter abbreviation.

```
<Field name='accounts[Oracle].locCode'>
   <Expansion>
      <switch>
         <ref>location</ref>
         <case>
            <s>Austin</s>
            <s>AUS</s>
         </case>
         <case>
            <s>Houston</s>
            <s>HOU</s>
         </case>
         <case>
            <s>Dallas</s>
            <s>DAL</s>
         </case>
      </switch>
   </Expansion>
</Field>
```

The `<Expansion>` element is part of the Form XML language and can contain an expression. When this field is processed, the expression in the `<Expansion>` element is evaluated to determine the value of the field.

In this example, this element performs the reverse of the mapping performed by the location field. This field is also hidden by the absence of an assigned Display class. This lack of Display class prevents the field from being displayed in the form, but the field is still considered to be an active part of the form and will generate values for resource attributes through its <Expansion> expression.

NOTE For all forms except the User view, Expansion rules are run whenever the page is recalculated or the form is saved. For the User view, an <Expansion> tag runs when the userform is first loaded as well.

Workflow Transition Conditions

When defining a workflow process, you must specify the rules by which control passes from one workflow activity to another. A path between two activities is called a transition. A rule that governs the use of the transition is called a transition condition.

For example, consider the following activity definition:

```
<Activity name='Check Results'>


   <Transition to='Log Errors'>
      <gt> <ref>ERROR_COUNT</ref> <i>0</i> </gt>
   </Transition>


   <Transition to='end'/>


</Activity>
```

This activity defines two distinct transitions to separate activities: an activity named `Log Errors` and another named `end`. When workflow processes this activity, it will take the first transition for which the transition condition returns true.

In this example, the first transition has a condition that tests the value of the variable `ERROR_COUNT` to see if it is greater than zero. That transition is taken only if there is a positive error count. The second transition has no condition, and consequently will always be taken if the first transition condition is false.

Workflow Actions

A workflow activity can perform one or more *actions*. One possible action is the evaluation of an XPRESS expression, as shown in the example below.

```
<Activity name='Increment Counter'>
   <Action>
      <expression>
         <set name='counter'>
            <add> <ref>counter</ref> <i>1</i> </add>
         </set>
      </expression>
   </Action>

   <Transition to='Next'/>


</Activity>
```

When a workflow action is implemented in XPRESS, an XPRESS expression is wrapped in an `expression` element that is then placed within an `Action` element. In this example, the expression references the current value of a variable named *counter*, adds one to that value, then assigns the incremented value to the variable with the same name.

Invoking Java Methods from Workflow Actions

Complex workflow actions can be implemented in Java. Typical examples of complex workflow actions include storing data in a relational database or sending a message to a help desk system. These Java classes can be integrated with workflow using XPRESS.

```
<Activity name='Log Status'>


   <Action>
      <expression>
         <invoke name='logStatus'
            class='custom.OracleStatusLog'>
            <ref>accountId</ref>
            <ref>email</ref>
            <ref>status</ref>
         </invoke>
      </expression>
   </Action>
   <Transition to='Next'/>


</Activity>
```

In this example, the XPRESS `invoke` function is used to call a static method named `logStatus`, which is defined in the custom Java class `custom.OracleStatusLog`. Three arguments are passed to this method, the values of which are taken from workflow variables.

In these types of cases, the primary computation is performed in the Java class, while XPRESS acts to integrate the class into the workflow.

Testing Expressions

Testing expressions involves two steps:

1. Checking XML Syntax with the lh Command
2. Tracing XPRESS Evaluation

Checking Expression Syntax with lh Command

To check the XML syntax of expressions without actually evaluating their logic:

1. Confirm that you have `%WSHOME%\bin` in your `PATH` environment variable. (For information on changing environment variables to work with Identity Manager, see the section of *Identity Manager Installation* that describes using command-line tools.)

   If `%WSHOME%\bin` is not in your path, then you must change to `%WSHOME%\bin` before you can run the tools.

2. From the command line, enter **`lh xmlparse <xpress_file>`** where **`xpress_file`** represents the name of the file that contains the XML you want to test. This command parses the file for XML correctness and displays error messages in the console.

NOTE Consider putting %WSHOME%\bin in your PATH environment variable. This will permit you to use whichever directory you are currently in as your working directory. This will also allow you to run the Identity Manager lh command from any current working directory.

Tracing XPRESS Evaluation

Once you have written and successfully stored an expression in the repository, you can turn on XPRESS tracing to determine if the expression is functioning correctly. XPRESS trace messages are sent to the standard output device. Since XPRESS is typically evaluated within the application server, the trace messages are sent to the console window or log file that was active when the application server was started.

There are two forms of XPRESS tracing:

- **Global trace**. When global trace is enabled, all XPRESS expressions are traced.
- **Block-level trace**. When block level tracing is used, only expressions within designated blocks are traced. Block tracing can be set only within a field element in a form or within an expression in a workflow.

Typically, block-level tracing is preferable because it reduces the amount of trace output, which is then easier to analyze.

Enabling Tracing

To enable global trace, set a `Waveset.properties` file entry named `xpress.trace` to the value true. If you change the `Waveset.properties` file while the application server is running, you must either restart the application server, or go to the Debug Page and click **Reload Properties**.

To perform block-level trace, wrap the expressions you want to trace in a `<block>` expression and include the attribute `trace='true'` in the block start tag.

```
<block trace='true'>
   <invoke name='getTime' class='java.util.Date'/>
</block>


or


<Default>
   <block trace = 'true'>
      <ref>global.accountId</ref>
   </block>
</Default>
```

Invalid Examples

Do not use the `<block>` element in the following ways.

```
<block trace='true'>
   <Field name ='field1'>
…
   </Field>
</block>


or


<Field name='Field2'>
   <block trace='true'>
      <Default>
         <ref>global.accounts</ref>
      </Default>
   </block>
</Field>
```

The trace messages include the names of the functions, the values of each argument, and the return values.

To turn tracing off for XPRESS, set the `xpress.trace` value to `false`, and reload the `Waveset.properties` file.

Functions

Identity Manager ships with a library of XPRESS functions that can be used in expressions. These functions are classified into the following categories:

- Value constructor expressions
- Arithmetic expressions
- Logical expressions
- String manipulation expressions
- List manipulation expressions
- Conditional, iteration, and block expressions
- Variable and function definition expressions
- Object manipulation expressions
- Java and JavaScript expressions
- Debugging and testing expressions

Value Constructor Expressions

In XPRESS, literal values are written as text contained with an XML element. The element name is the name of a function, and the literal text is the argument to the function. The following functions are provided for constructing simple atomic data types.

array Function

Builds a value of type *list* by evaluating each of the argument expressions and concatenating the return values. The expression can take multiple arguments. Null values are not filtered.

Example

```
<array>
   <s>apples</s>
   <s>oranges</s>
   <s>wiper blades</s>
</array>
```

i Function

Constructs an integer value. The function takes one argument, which must be literal text. The text should contain only numeric digits and can be optionally preceded by a plus or minus.

Example 1

```
<i>0</i>
```

Example 2

```
<i>42</i>
```

Example 3

```
<i>-1234</i>
```

list Function

Builds a value of type *list* by evaluating each of the argument expressions and concatenating the return values. The expression can take multiple arguments. Null values will be filtered.

Example

```
<list>
   <s>apples</s>
   <s>oranges</s>
   <s>wiper blades</s>
</list>
```

map Function

Creates a map that consists of the key-value pairs of each subexpression.

Example

```
<map>
   <!--Key 1-->
   <!--Value 1-->
   <!--Key n-->
   <!--Value n-->
</map>
```

null Function

Constructs a null value.

Example 1

```
<null/>
```

Example 2

```
<null></null>
```

s Function

Constructs a string value. The function takes one argument, which must be literal text. (Length is constrained only by the amount of contiguous memory available in your Java environment.)

Example

```
<s>Now is the time</s>
```

Arithmetic Expressions

Use the following functions to perform arithmetic processing within expressions.

add Function

Performs integer summation over the values of all arguments. Arguments that are not integers are coerced to integers.

Example

The following expression results in an integer (42).

```
<add> <i>40</i> <i>1</i> <s>1</s> </add>
```

div Function

Performs successive integer division over the values of all arguments. Arguments that are not integers are coerced to integers.

Example

The following expression results in an integer (42).

```
<div> <i>84</i> <i>2</i> </div>
```

mod Function

Performs successive integer modulo over the values of all arguments. Arguments are coerced to integers. Arguments of type `null` are ignored.

Example

The following expression results in an integer (42).

```
<mod> <i>142</i> <i>100</i> </mod>
```

mult Function

Performs successive integer multiplication over the values of all arguments. Arguments that are not integers are coerced to integers.

Example

The following expression results in an integer (42).

```
<mult> <i>7</i> <i>3</i> <i>2</i> </mult>
```

sub Function

Performs successive integer subtraction over the values of all arguments. Arguments that are not integers are coerced to integers.

Example

The following expression results in an integer (42).

```
<sub> <i>50</i> <i>6</i> <i>2</i> </sub>
```

Logical Expressions

Use the following functions to perform logical operations within expressions. Most logical functions return `1` and `0` to indicate true or false. The exceptions are `cmp`, `ncmp`, `and`, and `or`.

and Function

Takes any number of arguments and returns zero if any argument values are logically false. If one child evaluates to false, the function does not evaluate subsequent children. If all arguments are logically true, the function returns the value of the last argument. Zero (`<i>0</i>` or `<s>0</s>`) and `<null>` are considered logically false.

Example 1

The following expression returns zero.

```
<and> <i>42</i> <s>cat</s> <i>null</i> </and>
```

Example 2

The following expression returns `cat`.

```
<and> <i>42</i> <s>cat</s> </and>
```

cmp Function

Compares two string values. You can use this function to sort a list of strings

The function returns:

- *negative number* – value of the first argument is lexically less than the second.
- *positive number* – first argument is lexically greater than the second
- `0` (zero) – arguments are equal

Arguments are coerced to strings, if necessary.

Example 1

The following expression returns `-1`.

```
<cmp>
   <i>20</i>
   <i>100</i>
</cmp>
```

Example 2

The following expression returns -16. This expression returns a number that indicates the difference between the letters `r` and `b` when presented in alphabetical order. Since there are 16 letters between the letters `b` and `r`, when `bob` is compared to `ray`, the value is -16. Alternatively, if `r` were compared to `b`, the value returned would be 16.

```
<cmp>
   <s>bob</s>
   <s>ray</s>
</cmp>
```

Example 3

The following expression returns `0` (zero).

```
<cmp>
   <s>daryl</s>
   <s>daryl</s>
</cmp>
```

eq Function

Performs an equality test. The function can take multiple arguments, although typically it has only two. The data type of the first argument defines how the equality test is performed. If the first argument is of type:

- `string` – all subsequent arguments are coerced to strings, and string comparison is performed
- `integer` – all subsequent arguments are coerced to integers, and numeric comparison is performed
- `object` – all subsequent arguments must be of type object, and the value of Object.equals is true for each

This function returns:

`0` – statement is logically false

`1` – statement is logically true

Example

```
<eq> <ref>role</ref> <s>engineering</s> </eq>
```

gt Function

Takes two arguments.

This function returns:

- `0` – the first argument is numerically less than or equal to the second
- `1` – the first argument is numerically greater than the second

Example

```
<gt>
   <ref>age</ref>
   <i>42</i>
</gt>
```

gte Function

Takes two arguments.

This function returns:

- `0` – first argument is less than the second
- `1` – the first argument is numerically greater than or equal to the second

Example

The following expression returns 1.

```
<gte>
   <i>10</i>
   <i>5</i>
</gte>
```

isFalse Function

Used when referencing Boolean values that are represented with the strings `true` and `false` rather than the number 0 and 1. Takes one argument.

This function returns:

- `0` – the argument is logically true. The following are considered true: the string `true`, a Boolean true, and a non-zero integer. (Anything else is considered false.)
- `1` – the argument is logically false or returns the string `false`.

Example

The following expression returns 1.

```
<isFalse>
   <s>false</s>
</isFalse>
```

isnull Function

Takes one argument.

This function returns:

- `0` – statement is non-null
- `1` – statement is null.

Example 1

The following expression returns `1`.

```
<isnull> <null/> </isnull>
```

Example 2

The following expression returns `0`.

```
<isnull> <i>0</i> </isnull>
```

isTrue Function

Used when referencing Boolean values that are represented with the strings `true` and `false` rather than the number 0 and 1. Takes one argument.

This function returns:

- `0` – the argument is logically false. The following are considered true: the string `true`, a Boolean true, and a non-zero integer. (Anything else is considered false.)
- `1` – the argument is logically true.

Example

The following expression returns 0.

```
<isTrue>
   <s>false</s>
</isTrue>
```

lt Function

Takes two arguments.

This function returns:

- `0` – first argument is numerically greater than or equal to the second
- `1` – first argument is numerically less than the second

Example 1

The following expression returns `0` (zero).

```
<lt>
   <i>10</i>
   <i>5</i>
</lt>
```

Example 2

The following expression returns `1`.

```
<lt>
   <i>5</i>
   <i>10</i>
</lt>
```

lte Function

Takes two arguments.

This function returns:

- `0` – first argument is numerically greater than the second
- `1` – first argument is numerically less than or equal to the second

Example

```
<lte>
   <ref>age</ref>
   <i>42</i>
</lte>
```

ncmp Function

Performs case-insensitive comparison of two string values.

This function returns:

- *negative number* – indicates that the value of the first argument is lexically less than the second
- *positive number* – indicates that the first argument is lexically greater than the second
- `0` (zero) – indicates that the arguments are equal

Arguments are coerced to strings, if necessary.

Example

The following expression returns 0.

```
<ncmp>
   <s>Daryl</s>
   <s>daryl</s>
</ncmp>
```

neq Function

Performs an inequality test. Its behavior is simply the negation of the equality test performed by the `eq` function.

This function returns:

- `0` – the two arguments are equal
- `1` – the two arguments are not equal

Example

```
<neq>
   <ref>role</ref>
   <s>management</s>
</neq>
```

not Function

Reverses the logic of the nested expression.

This function returns:

- `1` – the value of the argument is logically false
- `0` – argument is logically true

Example

The following example returns `1`.

```
<not> <eq> <i>42</i> <i>24</i> </eq> </not>
```

or Function

Takes multiple arguments.

This function returns:

`0` – all arguments are logically false

Value of the first argument expression that results in a logically true value

Example 1

The following expression returns 0, which is logically false.

```
<or> <i>0</i> <i>0</i> </or>
```

Example 2

The following expression returns the string `cat`, which is also logically true.

```
<or> <i>0</i> <s>cat</s> </or>
```

notnull Function

Takes one argument

This function returns:

`0` – null argument

`1` – non-null argument

Example 1

The value of the following expression is 1 if the `firstname` has been set or 0 (zero) if `firstname` is null.

```
<notnull>
   <ref>firstname</ref>
</notnull>
```

Example 2

The value of the following expression is 0 because the value is null.

```
<notnull><null/></notnull>
```

String Manipulation Expressions

Use the following functions to perform string manipulation within expressions.

indexOf Function

Returns the position of a string within another string.

Example

The following function returns 3.

```
<indexOf>
   <s>abcabc</s>
   <s>abc</s>

   <s>l</s>
</indexOf>
```

concat Function

Concatenates two or more string values.

Example

The following expression returns `<s>Now is the time</s>`.

```
<concat>
   <s>Now </s><s>is </s><s>the </s><s>time</s>
</concat>
```

downcase Function

Takes a single argument, which is coerced to a string. It returns a copy of the argument with all upper case letters converted to lower case.

Example

The following expression returns `<s>abc</s>`.

```
<downcase><s>ABC</s></downcase>
```

length Function

Returns the number of elements in the list. You can also use this function to return the length of a string.

first argument – list or string

Example 1

The following expression returns `2`.

```
<length>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
</length>
```

Example 2

```
<length>
   <s>Hello world!</s>
</length>
```

This expression returns a value of `11`.

ltrim Function

Takes a single argument, which is coerced to a string.

It returns a copy of the argument with the leading white space removed.

Example

The following expression returns `<s>hello</s>`.

```
<ltrim><s>   hello</s></ltrim>
```

match Function

Deprecated. Use the `contains` function instead.

message Function

Formats a message by message catalog key.

Example

```
<message severity-'ok' name='DEFAULT_MESSAGE'>
   <!--message parameter 0-->
   <!--message parameter n-->
</message>
```

pad Function

Pads a string with spaces so that it reaches a desired length.

first argument – the string to `pad`

second argument – desired length

third argument – (optional) specifies the `pad` character, which by default is a space

Example

The following expression results in `<s> email  </s>`

```
<pad>
   <s> email</s>
   <i>10</i>
</pad>
```

rtrim Function

Takes a single argument, which is coerced to a string. It returns a copy of the argument with the trailing white space removed.

Example

This example returns 0 (zero).

```
<cmp>
   <s>hello</s><rtrim><s>hello   </s></rtrim>
</cmp>
```

split Function

Splits a string into a list of strings.

first argument – string to be split

second argument – a set of one or more string delimiters. Each character in this string will cause a break.

A list is created that contains each substring between delimiters.

Example 1

```
<split>
   <s>Austin City Limits</s>
   <s> </s>
</split>
```

This expression returns the following list.

```
<list>
   <s>Austin</s>
   <s>City</s>
   <s>Limits</s>
</list>
```

Example 2

The following expression uses multiple delimiters.

```
<split>
   <s>(512)338-1818</s>
   <s>()-</s>
</split>
```

This expression returns the following list.

```
<list>
   <s>512</s>
   <s>338</s>
   <s>1818</s>
</list>
```

substr Function

Extracts ranges of characters from a string.

This function takes two forms:

- *start* and *length* are specified as arguments (child nodes of the `substr` element).
- *start* and *length* are specified as attributes of the substr node *s* for *start* and `l` for *length*.

For example, these two invocations are equivalent:

```
<substr>
   <s>Hello World</s>
     <i>3</i>
     <i>4</i>
<substr>
```

and

```
<substr s='3' l='4'>
   <s>Hello World</s>
<substr>
```

Both functions return the string `lo W`.

```
<block>
   <substr s='3' l='4'>
      <s>Hello World</s> --> Hello World
   </substr> --> lo W
</block> --> lo W
```

The *start* and *length* parameters are optional. If the *start* argument is missing, either because only the string is specified as a child of the substr node as in

```
<substr>
   <s>Hello World</s>
<substr>
```

and the attribute *s* is also missing from the substr node, the start is assumed to be the beginning of the string. In other words, its value is zero if not specified explicitly.

first argument – string

second argument – starting position

third argument – number of characters to retrieve

Examples

The following expression returns `<s>Now</s>`.

```
<substr>
   <s>Now is the time</s>
   <i>0</i>
   <i>3</i>
</substr>
```

In the following example, the *start* attribute is missing, but is assumed to be 0:

```
<block>
   <substr l='4'>
       <s>Hello World</s> --> Hello World
   </substr> --> Hell
</block> --> Hell
```

The *length* argument is also optional. A missing *length* argument causes the function to extract the rest of the string. *length* can be unspecified when only the *string* and *start* arguments are specified a child nodes of substr such as:

```
<substr>
   <s>Hello World</s>
       <i>3</i>
<substr>
```

or when the *l* attribute is missing from the substr node like. Note that the *length* argument is unspecified below, but the rest of the string starting from this start is returned:

```
<block>
   <substr s='3'>
      <s>Hello World</s> --> Hello World
   </substr> --> lo World
</block> --> lo World
```

trim Function

Takes a single argument, which is coerced to a string.

It returns a copy of the argument with the leading and trailing white space removed.

Example

The following expression returns `<s>hello</s>`.

```
<trim><s> hello </s></trim>
```

upcase Function

Takes a single argument, which is coerced to a string.

It returns a copy of the argument with all lower case letters converted to upper case.

Example

The following expression returns `<s>ABC</s>`.

```
<upcase><s>abc</s></upcase>
```

ztrim Function

Returns the string value of the subexpression with leading zeros removed.

Example

```
<ztrim>
   <s>00000sample</s>
</ztrim>
```

This function evaluates to <s>sample</s>.

List Manipulation Expressions

Most list manipulation functions have two forms depending upon whether the `name` attribute is included in the function element:

- If included in the function element, the name is expected to resolve to a variable containing a list. In this case, the referenced variable is destructively modified. The following example modifies the list stored in the `someList` variable and adds two elements:

```
<append name='someList'>
   <s>Hello</s>
   <s>World</s>
</append>
```

If the name is not included in the function element, a new list is constructed. In the following example, a new list is created by combining the elements of the list stored in the `someList` variable with two additional elements. The value of the `someList` variable is not modified.

```
<append>
   <ref>someList</ref>
   <s>Hello</s>
   <s>World</s>
</append>
```

Use the following functions to manipulate list elements.

append Function

Appends a value to a list. The argument list takes one of two forms depending on the presence of the *name* attribute. If *name* is not specified, then the first argument must be a list and the remaining arguments are elements to append to that list. A copy of the list is returned, the original list is not modified. If the *name* argument is used, then all arguments are considered objects to be appended to the list contained in the variable with that name. The list is modified without being copied.

Example 1

The following expression makes a copy of the list contained in the variable *srclist* then appends one element.

```
<append>
   <ref>srclist</ref>
   <s>oranges</s>
</append>
```

Example 2

The following expression modifies an existing list by appending a value.

```
<set name= 'somelist'>
  <List>
    <s>We</s>
    <s>say</s>
  </List>
</set>

<append name= 'somelist'>
  <s>Hello</s>
  <s>World</s>
</append>
<ref>someList</ref>
```

appendAll Function

Merges the elements in multiple lists. If the `name` attribute is specified, an existing list is modified. Otherwise, a new list is created.

Example 1

The following expression creates a new list by combining the elements in *srclist* with three additional elements.

```
<appendAll>
   <ref>srclist</ref>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>peaches</s>
   </list>
</appendAll>
```

Example 2

The following expression adds three elements to the list stored in the variable *srclist*.

```
<appendAll name='srclist'>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>peaches</s>
   </list>
</appendAll>
```

contains Function

first argument – list or string

second argument – any object to search for in the list or a substring to search for in the string

This function returns:

1 -- list contains a given value or the string contains the given substring

Example 1

The following expression returns 1.

```
<contains>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
   <s>apples</s>
</contains>
```

Example 2

The following expression returns 1

```
<contains>

   <s>foobar</s>

   <s>foo</s>

</contains>
```

containsAll Function

Takes two list arguments.

This function returns:

`1` -- the list contains all elements contained in another list

0 (zero) -- the list does not contain all elements contained in the second list

Example

The following expression returns 0.

```
<containsAll>
   <ref>fruitlist</ref>
   <list>
      <s>oranges</s>
      <s>wiper blades</s>
   </list>
</containsAll>
```

containsAny Function

first argument – list to be searched

second argument – an element or a list of elements to search for in the first list

This function returns:

1 -- first list contains any elements that are contained in a second list.

0 (zero) -- first list does not contain any elements that are contained in a second list.

Example

The following expression returns 1.

```
<containsAny>
   <ref>fruitlist</ref>
   <list>
      <s>oranges</s>
      <s>wiper blades</s>
   </list>
</containsAny>
```

filterdup Function

Filters duplicate elements from a list. Given a list, it returns a new list in which duplicate entries have been removed.

Example 1

```
<filterdup>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>apples</s>
   </list>
</filterdup>
```

This expression returns the following list.

```
<list>
   <s>apples</s>
   <s>oranges</s>
</list>
```

Example 2

You can also use this function to manipulate an existing list rather than creating a new list.

```
<filterdup name = 'namedlist'/>
```

filternull Function

Filters null elements from a list.

This function returns a single list removing all null elements (when given one list).

Example

```
<filternull>
   <list>
      <s>apples</s>
      <null>
         <s>oranges</s>
      <null/>
   </list>
</filternull>
```

This expression returns the following list.

```
<list>
   <s>apples</s>
   <s>oranges</s>
</list>
```

Example 2

You can also use this function to manipulate an existing list rather than creating a new list.

```
<filternull name = 'namedlist'/>
```

expand Function

Returns the string value of the subexpression with $() variable references expanded.

Example

```
<expand><s>$(sample)</s></expand>
```

get Function

Retrieves the value of the nth element in the list. The list indexes starts count from zero (0). Arguments are a list and an integer.

Example

```
<get>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
   <i>1</i>
</get>
```

This expression returns `<s>oranges</s>`

indexOf Function

first argument – a list value to search

second argument – value for which to search

third argument – (optional) starting index

This function returns either the ordinal position of a list element that matches a given value or `-1` (the given value is not in the list).

Example 1

The following expression returns `1`.

```
<indexOf>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
   <s>oranges</s>
</indexOf>
```

Example 2

The following expression returns `3`.

```
<indexOf>

   <list

      <s>apples</s>

      <s>oranges</s>

   </list>

   <s>oranges</s>

<i>2</i>

</indexOf>
```

insert Function

Inserts a value into the list. Elements following the insertion index down are shifted to make room for the new element.

first argument – a list to which an element is inserted

second argument – integer specifying position in the list at which to insert the new element

third argument – value to insert into the list

Example 1

```
<insert>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
   <i>1</i>
   <s>wiper blades</s>
</insert>
```

This expression returns the following list.

```
<list>
   <s>apples</s>
   <s>wiper blades</s>
   <s>oranges</s>
</list>
```

This function can also take a named list.

```
<insert name='name_of_list'>

<! -- position in which to insert the list>

<! -- value to insert>

</insert>
```

Example 2

```
<insert name='variable name of list'>

   <!--the position at which to insert -->

   <--!the value to insert -->

</insert>
```

length Function

Returns the number of elements in the list. You can also use this function to return the length of a string.

first argument – list or string

Example 1

The following expression returns `2`.

```
<length>
   <list>
      <s>apples</s>
      <s>oranges</s>
   </list>
</length>
```

Example 2

```
<length>
   <s>Hello world!</s>
</length>
```

This expression returns a value of `11`.

remove Function

Removes one or more elements from a list. The argument list takes one of two forms depending on the presence of the `name` attribute. If `name` is not specified, then the first argument must be a list and the remaining arguments are elements that are removed from that list. A copy of the list is returned. (The original list is not modified.) If the `name` argument is used, then all arguments are considered objects to be removed from the list contained in the variable with that name. The list is modified without being copied.

Example 1

The following expression makes a copy of the list contained in the variable *srclist*, then removes one element and returns the copy of the list.

```
<remove>
   <ref>srclist</ref>
   <s>oranges</s>
</remove>
```

Example 2

The following expression modifies an existing list by removing a value.

```
<set name= 'somelist'>
  <List>
    <s>We</s>
    <s>say</s>
  </List>
</set>

<remove name= 'somelist'>
  <s>say</s>
  <s>say</s>
</remove>
<ref>someList</ref>
```

removeAll Function

Removes all elements contained in one list from another list. If the `name` attribute is specified, an existing list is modified. Otherwise, a new list is created.

Example 1

The following expression creates a new list by removing the elements in *srclist* along with three additional elements.

```
<removeAll>
   <ref>srclist</ref>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>peaches</s>
   </list>
</removeAll>
```

Example 2

The following expression removes three elements in the list stored in the variable *srclist*.

```
<removeAll name='srclist'>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>peaches</s>
   </list>
</removeAll>
```

This expression results in the following list.

```
<list>
   <s>wiper blades</s>
</list>
```

retainAll Function

Computes the intersection of two lists, and returns elements contained in both lists.

This function has two variants.

Example 1

Sets a named list to an intersection of it and the another list.

```
<retainAll name='variable name of list'>
<!-- the other list-->
</retainAll>
```

Example 2

Returns the intersection of two lists.

```
<retainAll>
   <!-- the first list>
  <!-- second list-->
</retainAll>
```

setlist Function

Assigns a value into a specified position in a list, overwriting its current value. If necessary, the list is extended to contain the indexed element. New elements created during list extension will be null.

first argument – list

second argument – integer specifying position in the list at which to insert the new element, starting with zero.

third argument – element

Example 1

```
<setlist>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>wiper blades</s>
   </list>
   <i>2</i>
   <s>bassoons</s>
</setlist>
```

This expression results in the following list and returns null.

```
<list>
   <s>apples</s>
   <s>oranges</s>
   <s>bassoons</s>
</list>
```

Example 2

```
<setlist>
   <list>
      <s>apples</s>
      <s>oranges</s>
      <s>wiper blades</s>
   </list>
   <i>5</i>
   <s>bassoons</s>
</setlist>
```

This expression results in the following list and returns null.

```
<list>
   <s>apples</s>
   <s>oranges</s>
   <s>wiper</>
   </null>
   </null>
   <s>bassoons</s>
</list>
```

Conditional, Iteration, and Block Expressions

Use these functions to perform conditional and block processing within expressions.

block Function

Groups more than one expression into a single expression. The value of the block function is the value of its last argument.

NOTE The `<set>` function does not return a value. If the last line in a block statement involves a set operation, the block statement will not return a value. If you want the block statement to return the value of a variable, use `<ref>variable_name</ref>` on the last line of the block statement.

Example

```
<block>
   <s>Hello there!</s>
   <add> <i>100</i> <i>2</i> </add>
   <i>42</i>
</block>
```

The block returns a value of `42`, the value of its last argument.

For an example of using block with a trace statement, see Debugging and Testing Expressions.

break Function

Forces early termination of an expression. A break can be used within the following expressions: `block`, `dolist`, `while`, `and`, `or`. The value of the `break` expression becomes the value of the containing expression. The break can cause the termination of several levels of expression when the optional block name is used.

Example 1

The following expression contains a simple break terminating a loop.

```
<dolist name='el'>
<ref>list</ref>
   <cond><eq><ref>el</ref><s>000</s></eq>
      <break>
         <ref>el</ref>
      </break>
   </cond>
<null/>
</dolist>
```

In this example, the `dolist` function iterates over the elements of a list looking for value 000. The value of the `dolist` function is a list formed by concatenating the values that are returned by the last subexpression in each iteration.

Example 2

The following expression demonstrates the use of a block name to break through more than one level.

```
<block name='outer block'>
  <dolist name='el'>
    <ref>listOfLists</ref>
    <dolist name='el2'>
      <ref>el</ref>
      <cond><eq><ref>el</ref><s>000</s></eq>
        <break name='outer block'>
          <ref>el</ref>
        </break>
      </cond>
    </dolist>
    <null/>
  </dolist>
</block>
```

This is similar to the previous example except that there are two loops. The outer loop iterates over a list whose elements are themselves lists. The inner loop iterates over the element lists. When the value 000 is found, both loops are terminated by referencing the block name `outer block` in the `break` expression.

cond Function

Provides a way to conditionally select the value of one of two expressions. It is similar to the ternary conditional operator (a?b:c) in C and Java.

Example

The `cond` function allows three arguments. The first argument is called the *condition*. If the value of the condition is logically true, the value of the *cond* will be the value of the second argument. If the value of the condition is false, the value of the *cond* will be the value of the third argument. If the value of the condition is false, and the third argument not present, the value of the *cond* is null.

```
<cond>
   <gt>
      <ref>age</ref>
      <i>40</i>
   </gt>
   <s>old</s>
   <s>young</s>
</cond>
```

dolist Function

Iterates over the elements of a list. The value of the `name` attribute will become the name of variable that can be referenced within the loop.

The value of this variable will be the value of successive list elements.

The first subexpression returns the list over which to loop. The remaining subexpressions are repeated once for each element in the list.

The value of the `dolist` function is a list formed by concatenating the values returned by the last subexpression in each iteration.

Example

The following expression creates a list called `subset`, which contains the subset of elements in *srclist* that exceed 10.

```
<set name='subset'>
   <dolist name='el'>
     <cond>
       <gt>
         <ref>el</ref>
         <i>10</i>
       </gt>
       <ref>el</ref>
     </cond>
   </dolist>
</set>
```

switch Function

first argument - any XPRESS expression

second arguments - series of `<case>` elements

The first argument is evaluated and compared against each of the <case> elements until a match is found. The `<switch>` function evaluates to the first `<case>` for which there is a match. If no match is found, the `<switch>` evaluates to the `<case>` element where `default='true'`.

Example

The following expression returns `apples`.

```
<switch>
   <s>A</s>
   <case default='true'>
      <s>unknown</s>
   </case>
   <case>
      <s>A</s>
      <s>apples</s>
   </case>
   <case>
      <s>B</s>
      <s>oranges</s>
   </case>
</switch>
```

select Function

Returns the first non-null (and non-zero) value in a list.

Example

```
<select>
   <ref>:display.session</ref>
   <ref>context</ref>
</select>
```

If you have the following statement:

```
<select>
   <ref>first/ref>
   <ref>second</ref>
   <ref>third</ref.
</select>
```

This statement would first check to see if `first` was null. If not, it would return the value of `first`, or move on to the next item until one returns true or all items are exhausted.

You can use this function when you need to obtain the correct context from, for example, a workflow or when calling a formUtil method.

Using select in this way allows you to call formUtil methods from anywhere in Identity Manager without knowing which variable houses the Lighthouse Context. In a form, you would specify the context with `<ref>:display.session</ref>`. However, for the same FormUtil call in a Workflow, you must instead use `<ref>context</ref>`.

while Function

Repeats a set of expressions until a condition is met. The first subexpression is called the `conditional` and will be evaluated each time through the loop. The loop terminates when the conditional is logically false. The value of the `while` expression is the value of the last expression in the loop during the last iteration.

Example

The following expression returns null.

```
<while>
   <gt>
      <ref>counter</ref>
      <i>0</i>
   </gt>

   <set name='counter'>
      <sub> <ref>counter</ref>
         <i>1</i>
      </sub>
   </set>
</while>
```

Variables and Function Definition Expressions

Use the following functions to reference and define variables and functions within expressions.

ref Function

References the value of a variable. The variable can either be an external variable supported by the host application or an internal variable defined with `<defvar>`.

Example 1

```
<ref>waveset.role</ref>
```

Example 2

```
<defvar name='milk'><s>milkvalue</s></defvar>

<defvar name='shake'><s>milk</s></defvar>

<ref><ref>shake</ref>
```

evaluates to `<s>milkshake</s>`

defvar Function

Defines a new variable. The variable can then be referenced by any expression within and below the containing expression in which the variable was defined. The variable must be given a name using the XML attribute `name`.

A `defvar` statement should not reference itself. If it does, it will cause a loop.

NOTE Avoid the following constructions.

```
<defvar name='fullname'>
   <ref>fullname</ref>
</defvar>
```

or

```
<defvar name='counter'/>
   <add><ref>counter</ref>
      <i>0</i>
   </add>
</defvar>
```

Example 1

The following expression defines a variable and initializes its value to a list of two elements.

```
<defvar name='theList'>
  <list>
     <s>apples</s>
     <s>oranges</s>
  </list>
</defvar>
```

Example 2

The following expression defines a variable and initializes its value to the integer zero.

```
<defvar name='counter'>
   <i>0</i>
</defvar>
```

defarg Function

Defines an argument within a function defined with `<defun>`. Arguments are similar to variables, but they must be defined in the order in which arguments are passed to the function.

Example

```
<defarg name='arg1'/>
<defarg name='arg2'/>
```

defun Function

Defines a new function. The <defarg> function must be used to declare the arguments to a function. Use the <call> function to execute the function. Functions are typically defined within forms.

Example

```
<defun name='add100'>
   <defarg name='input'/>
   <add>
      <ref>input</ref>
      <i>100</i>
   </add>
</defun>
```

call Function

Calls a user-defined function. The arguments to call are assigned to arguments with `<defarg>` in the so-called function. The order of the `call` arguments must match the order of the `<defarg>`s. In previous releases, the `call` function could be used to call rules. Now, use the rule function for that purpose.

Example

The following expression returns `142`.

```
<call name='add100'>
   <i>42</i>
</call>
```

rule Function

Calls a rule. The arguments to rule are passed by name using the argument element. The value of an argument can be specified with the value attribute if it is a simple string. The argument value can also be calculated with an expression by omitting the value attribute and instead writing an expression within the body of the argument element.

A `<rule>` element can also call another rule that dynamically calculate the name of another rule to call.

For more information on creating or calling rules in forms and workflows, see the chapter titled *Rules*.

Examples

The following expression returns the employee ID of the designated user.

```
<rule name='getEmployeeId'>
   <argument name='accountId' value='maurelius'/>
</rule>
```

```
<rule name='getEmployeeId'>
   <argument name='accountId'>
      <ref>username</ref>
   </argument>
</rule>
```

The following expression calls another rule that calculates the returned value.

```
<rule>
   <cond>
     <eq><ref>var2</ref><s>specialCase</s></eq>
     <s>Rule2</s>
     <s>Rule1</s>
   </cond>
   <argument name='arg1'>
     <ref>variable</ref>
   </argument>
</rule>
```

Object Manipulation Expressions

Use the following functions to manipulate arbitrary object values within expressions.

get Function

Retrieves a value from within an object. The

first argument – Must be a List, Map, or Object.

second argument – Must be a String or Integer. If the first argument is a List, the second argument is coerced to an integer and used as a list index. If the first argument is a GenericObject, the second argument is assumed to be the name of a JavaBean property.

The function behaves differently if the first argument is a list. If the first argument is a list, then the second argument is an integer list index. The element at that index is returned.

Example

This expression returns a string that is the name of the currently assigned role for the user.

```
<get>
   <!--List, Map, or Object -->
   <!-- String -->
</get>
```

This expression is equivalent to call `userView.getRole()` in Java code.

putmap Function

Assigns map elements to an object.

`map` – specifies the map.

`key` – specifies the map key.

`value` – specifies the value to assign to the map key.

Example

```
<putmap>
   <ref>userView</ref>
   <s>waveset.role</s>
   <s>engineering</s>
</putmap>
```

setlist Function

Assigns list elements to an object.

`list` – specifies the list

`index` – specifies the order of elements in the list

`value` – specifies the value to assign to the list element

Example

```
<setlist>
   <ref>myList</ref>
   <i>s</i>
   <s>accounts</s>
</setlist>
```

setvar Function

Set the value on the variable. This function accepts a static variable name.

`name` – identifies the name of the variable

`value` – specifies the value to assign to the variable

Example

```
<setvar>
   <ref>var</ref>
   <s>text</s>
</setvar>
```

instanceof

Identifies whether an object is an instance of the type specified in the `name` parameter.

`name` – identifies the object type you are checking against.

This function returns 1 or 0 (true or false) depending on whether the sub expression object is an instance of the type specified in the `name` parameter.

Example

The following expression returns 1 because ArrayList is a List

```
<instanceof name='List'>
   <new class='java.util.ArrayList'/>
</instanceof>
```

Java and JavaScript Expressions

Use the following functions to call and manipulate Java classes or JavaScript functions from within expressions.

invoke Function

Invokes a method on a Java object or class.

There are two forms of this function:

static method

```
<invoke class='class name' name='method name'>
   <!--method argument 0 -->
   <!--method argument n-->
</invoke>
```

instance method

```
<invoke class='method name'>
   <!--the object to invoke the method on -->
   <!--method argument 0 -->
   <!--method argument n-->
</invoke>
```

To use this function, you must be familiar with the class and method names you want to call, the arguments they take, and the method's actions. This function is frequently used to call the following Identity Manager classes:

- FormUtil
- LighthouseContext
- WorkflowContext
- WavesetResult

For more information, see the available documentation for these classes.

new Function

Creates an instance of a Java class. The class name is provided in the XML `class` attribute and must be fully qualified with the class package name.

You can also use this function to create a new object and return it as the value of an expression or rule without necessarily invoking methods on it.

Example

```
<new class='classname'/>

   <!--constructor argument 0-->

   <!--constructor argument n-->

</new>
```

script Function

Encapsulates a fragment of JavaScript. When this expression is evaluated, the JavaScript interpreter is launched to process the script. The value of the expression is the value of the last JavaScript statement. Within the script, the object `env` can be used to access variables in the host application.

Avoid using JavaScript in performance-critical expressions such as `<Disable>` expressions in forms. Short XPRESS expressions are easier to debug using the built-in tracing facilities. Use JavaScript for complex logic in workflow actions.

Example

```
<script>
   var arg1 = env.get('arg1');
   arg1 + 100;
</script>


<script>
   importPackage(Packages.java.util);
   var cal Now = Calendar.getInstance();
   cal Now.getTime()
</script>
```

Debugging and Testing Expressions

Enabling tracing can result in a large amount of trace data.

Use the following functions to enable expression trace or print text to help diagnose problems in an expression.

NOTE Globally enabling trace may result in a large amount of trace data being printed. If it is usually better to enable trace at the block level by setting the trace attribute of the block element to true.

trace Function

Enables or disables expression tracing. If the argument evaluates to `true`, tracing is enabled.

If tracing is enabled, it will go to standard output.

Example 1

```
<trace><i>1</i></trace>
```

Example 2

```
<trace><i>0</i></trace>
```

print Function

Prints the value of each subexpression to standard output.

Example

```
<print>
   <s>Ashley World!</s>
</print>
```

Data Types

All functions return a value that has one of the data types listed in the following table.

Table 4-1 Return Value Data Types

Data Type	Definition
`integer`	Represents a signed integral value. The precision of the value is at least 32 bits.
`list`	Represents ordered lists of other values. The values in a list are called *elements*. List elements can be null. A list lacking elements is not considered to have a null value.
`null`	Represents the absence of a value. A function might return null if it is called only for side effect, or if it cannot compute a meaningful value from the given arguments. The way a null value is handled depends on the function being passed a null argument. In general, a null value is considered to be logically false and is ignored in arithmetic expressions.
`object`	Represents references to arbitrary objects that are defined outside the XPRESS language.
`string`	Represents a string of characters. Since XML syntax is used, strings always use the Unicode character set. A string value can contain no characters. Such a string is considered *empty*, but it is not null.

Some functions treat the values of their arguments as being logically true or false. XPRESS does not use a Boolean data type. Instead, a value of null or an integer value of zero is considered false. Any other value is considered true.

Logical functions such as `eq` that return a Boolean value will return the integer zero to represent false and the integer 1 to represent true.

Chapter 5

XML Object Language

The *XML Object Language* is a collection of XML elements that you can use to represent common Java objects such as strings, lists, and maps.

Topics in this Chapter

- Understanding XML Object Language
- XML Object Language and Corresponding XPRESS

Related Chapters

- XPRESS Language — You use expressions to include logic in your forms.

Understanding XML Object Language

XML Objects are often used in forms, but you can also use them in workflows and rules. One common use is to create a list of allowed values for a `Select` or `MultiSelect` field in a form, as shown below.

Example

```
<Field name='global.state'>
    <Display class='Select'>
       <Property name='title' value='State'/>
       <Property name='allowedValues'>
         <List>
            <String>Alabama</String>
            <String>Alaska</String>
            <String>Arizona</String>
            <String>Arkansas</String>
            <String>California</String>
            <String>Washington</String>
            <String>Washington D.C.</String>
            <String>West Virginia</String>
            <String>Wisconsin</String>
            <String>Wyoming</String>
         </List>
       </Property>
    </Display>
</Field>
```

Elements in the XML Object language are similar to elements in the XPRESS language, but it is more efficient to use the XML Object language if the values are static.

These two languages differ primarily in that XML Object language does not allow the contents of an object to be computed with an expression. This restriction allows the system to construct the object more efficiently, which will result in faster processing if the object is large.

When defining lists with XML Object language, the list is created once when the form is read from the repository and reused thereafter. When defining lists with XPRESS, a new list is created every time the form is displayed.

XML Object Language and Corresponding XPRESS

The following table lists several basic XML objects and the equivalent XPRESS expressions, if available.

Table 5-1 Basic XML Objects and Equivalent XPRESS Expressions

XML Object Language	XPRESS Language
`<String>cat</String>`	`<s>cat</s>`
`<Integer>10</Integer>`	`<i>10</i>`
`<Boolean>true</Boolean>`	`<i>1</i>`
`<Boolean>false</Boolean`	`<i>0</i>`
`<null/>`	`<null/>`

`<Map>`
`  <MapEntry key='name' value='neko'/>`
`  <MapEntry key='ID' value='123'/>`
`</Map>`
	`<map>`
	`  <s>name</s>`
	`  <s>neko</s>`
	`  <s>ID</s>`
	`  <i>123</i>`
	`</map>`

`<List>`
`  <String>cat</String>`
`  <String>dog</String>`
`  <integer>673</Integer>`
`</List>`
	`<list>`
	`  <s>cat</s>`
	`  <s>dog</s>`
	`  <i>673</i>`
	`</list>`

`<Long>123456789</Long>`	N/A
`<Date>20020911 09:15:00</Date>`	N/A

You cannot use XPRESS statements within an XML object.

Using XML Objects in XPRESS

You can use XML objects within XPRESS anywhere an expression is allowed. In the example below, a map is passed as an argument to an invoked method.

```
<invoke name='printTheMap'>
    <ref>mapPrinter</ref>
       <Map>
       </Map>
</invoke>
```

In releases prior to 2.0, XPRESS required that all XML Objects be wrapped in an <o> element. While this is no longer required, you may still encounter its use in older files containing XPRESS.

When to Use XML Object Language Instead of XPRESS

Although both XML Object Language and XPRESS provide ways of representing lists in forms, XML Object syntax is more efficient than XPRESS if the list is long and contains static data. The list is built in memory once and it is reused every time it is referenced. In contrast, XPRESS list syntax is re-evaluated on every reference and a new list is created each time.

The XML object language is most typically used when creating lists of the information described in the following table.

Table 5-2 XML Use for Information Lists

Type of Information Lists	Where Used
Machine names	forms
Business sites	forms
Approver names	workflow

Representing Lists in XML Object Language and XPRESS

Both XML Object Language and XPRESS provide ways of representing lists in forms.

Using XPRESS to Represent a List

You use the <list> element when representing lists in XPRESS. The contents of the <list> element can be any XPRESS expression.

NOTE Use only the <list> XPRESS element in forms if the list must contain calculated elements. Using the <list> element can slow the execution of the form in which it is included. This degradation in performance is typically not noticeable unless the list contains many elements. It is permissible and common for forms to use <list>.

The following example uses the <s> string constants in the XPRESS list, but you can also use the <invoke> or <concat> elements to dynamically build the list elements.

Example

```
<list>
   <s>cat</s>
   <s>dog</s>
</list>
```

Using XML Object Language to Represent a List

The XML Object language uses the <List> element to represent lists. The contents of the <List> element can be only other XML Objects. In the following example, the content of the <List> element are <String> elements.

Example

```
<List>
   <String>cat</String>
   <String>dog</String>
</List>
```

Example Form Using Both Types of Syntax

The following form incorporates fields containing lists defined by both XML Object syntax and XPRESS.

```
<Form>

    <Field name='department'>
      <Display class='Select'>
        <Property name='allowedValues'>
          <List>
           <String>Engineering</String>
           <String>Marketing</String>
           <String>Sales</String>
          </List>
        </Property>
      </Display>
    </Field>


    <Field name='department2'>
      <Display class='Select'>
        <Property name='allowedValues'>
          <expression>
            <list>
              <s>Engineering</s>
              <s>Marketing</s>
              <s>Sales</s>
            </list>
          </expression>
        </Property>
      </Display>
    </Field>

</Form>
```

The `allowedValues` list in the department field is defined as a static list built with `<List>`. No matter how many times this form is used, only one list is created. In contrast, the `allowedValues` list in the `department2` field is defined with a `<list>` expression. A new list is created every time this form is used.

Defining Map Objects with XML Object Syntax and XPRESS

You can use either the XML Object syntax or XPRESS to dynamically construct Map objects. Using the XPRESS <map> element is similar to using the XML Object language <Map> and <MapEntry> elements. These elements differ in that the contents of <map> can be calculated using expressions. In contrast, the <Map> element can only define static maps.

NOTE Maps are sometimes used as arguments to methods that are called with an <invoke> expression. For example, certain methods in the FormUtil class require maps as arguments.

Using XPRESS to Represent a Map

The contents of the XPRESS <map> element are pairs of name/value expressions. The even-numbered expressions define map keys, and odd-numbered expressions define map values. If any key expression evaluates to null, the entry is ignored.

You can use the XPRESS <map> element to dynamically construct java.util.HashMap objects:

```
 <map>
   <s>name</s>
   <s>Jeff</s>
   <s>phone</s>
   <s>338-1818</s>
</map>
```

Using XML Object Syntax to Map Objects

You can use XML Object syntax to define map objects as follows:

```
<Map>
   <MapEntry key='name' value='Jeff'/>
   <MapEntry key='phone' value='338-1818'/>
</Map>
```

Chapter 6

HTML Display Components

This chapter describes the Identity Manager HTML display component library. HTML display components are used when customizing forms. See Chapter 2, “Identity Manager Forms” on page 59 for a discussion of the larger topic of customizing forms.

Topics in this Chapter

This section covers the following topics:

HTML Display Components

If you are designing forms, you will use the HTML components described in this section. To create a form, you can use the Identity Manager Form XML language (also called *forms*), to describe HTML display components. This language is then interpreted at runtime to build the necessary components. It allows new pages to be dynamically generated with little or no additional Java development, which greatly simplifies customization.

What Are HTML Components?

HTML display components are instances of Java classes that generate a string of HTML text. Each display component has:

- A *class name* (defined in the field by the class attribute of the `Display` element). This name identifies the component class, which determines the component's fundamental behavior and defines the set of properties recognized by the component.
- One or more *properties* (defined in the field with `Property` elements). Properties further define field behavior and appearance.

Specifying Display Components

You can specify display components as follows:

```
<Field name='Name'>
   <Display class='Class'>
      <Property name='Name' value='Value'/>
   </Display>
</Field>
```

Page Processor Requirements for HTML Components

Forms that implement HTML components have the following page processor requirements.

Hidden Parameters

Most components have a name that corresponds to the name of a parameter posted from an HTML form. Identity Manager reserves a few parameter names for general use. Do not use these names as component names.

Table 6-1 Hidden Parameters

Reserved Name	Description
id	Contains the ID of the object being edited
command	Contains the value of the button used to submit the form
activeControl	Contains the name of the last component that was active on the form
message	Can contain an informational message to be displayed at the top of the page
error	Can contain an error message to be displayed at the top of the page

Component Classes

HTML components are independent objects that can be combined in various ways. Related components are organized into classes. There are two major groups of component classes:

- **Basic Component classes** – Components used to display and edit a single value.
- **Container classes** – Components that can contain one or more components.

Basic Component Classes

Common component classes include the components that are used to display and edit a single value. These components are defined in the section titled "Basic Components".

Container Classes

A *container* class defines a collection of components that are visually organized in a certain way. Typically, creating a container class results in the generation of an HTML `table` tag. Simple containers can concatenate the components horizontally or vertically. Other containers allow more flexible positioning of components and may add ornamentation around the components.

Because containers are themselves components, any container can be placed inside another container. You can use this mechanism to build complex page layouts. For example, many pages consist of a title, followed by a list of editing fields, followed by a row of form submission buttons. You can create this by creating a `Panel` component using vertical orientation that contains a `Label` component, an `EditForm` component, and a `ButtonRow` component. The `EditForm` component itself contains some number of subcomponents. The `ButtonRow` component is simply a `Panel` that uses horizontal orientation and contains a list of `Button` components.

BorderedPanel

Defines five regions (north, south, east, west, and center) into which items can be placed. Components in the north and south regions are positioned horizontally. Components in all other regions are positioned vertically.

Properties include:

- `eastWidth` – Specifies the width of the east region
- `westWidth` – Specifies the width of the west region

ButtonRow

Sets default options for button placement. Extends the Panel component.

- `buttonDivStyle` - Specifies the CSS class to apply to a `div` surrounding the buttons.
- `defaultAlign` - Specifies the default alignment of the buttons in the row. Identity Manager consults this property if the `align` property has not been explicitly set on the row. Defaults to `left`.
- `defaultDivider` - Specifies whether to render a divider above or below the button row. Identity Manager consults this property if the divider property has not been explicitly set on the row. Defaults to `false`.
- `divider` – Specifies whether the divider should be rendered as a horizontal or blank line. When true, the divider will be rendered as a horizontal line (for example, an `<hr>`). (Boolean)
- `dividerStyle` - Specifies the CSS class to use to style the divider if it is rendered. If this property is not set, Identity Manager renders a horizontal rule. Defaults to `unset`.
- `pad` – Specifies where to insert this space between the button row and an adjacent component. Allowed values are top and bottom. If the value is null, no space is added. Default value is top.

EditForm

This display component is the default display class used to render forms in a browser.

Form components are positioned in two columns, with titles on the left, and components on the right. Flyover help can be included with the titles. Multiple components can be concatenated on a single row.

Most edited properties include `title`, `subTitle` and `adjacentTitleWidth`.

```
<Form name='Default User Form' help='account/modify-help.xml'>

   <Display class='EditForm'>

     <Property name='titleWidth' value='120'>

     <Property name='adjacentTitleWidth' value='60'>

   </Display>
```

Additional EditForm properties include:

- `adjacentTitleWidth` – Specifies the width of the titles of adjacent fields. If this property is not defined, it defaults to zero. If you define `adjacentTitleWidth` as equal to zero, columns titles will automatically resize. If set to a non-zero value, then the title width of adjacent columns (for example, the second and third columns) will be the value of `adjacentTitleWidth`.
- `border` - Specifies the width in pixels of the table that contains the `EditForm` component. Defaults to 0, which indicates no border.
- `cellpadding` - Specifies the cellpadding of the table that contains the `EditForm` component. Defaults to 5.
- `cellspacing` - Specifies the cellspacing of the table that contains the `EditForm` component. Defaults to 0.
- `componentTableWidth` – Specifies the width (in pixels) of the EditForm. If not specified, this defaults to either 400 pixels or the value of the `defaultComponentTableWidth` global property for EditForm
- `defaultComponentTableWidth` - Specifies the width in pixels of the table in which Identity Manager renders each component. Identity Manager consults this property if the `componentTableWidth` property has not been explicitly set on the `EditForm`. When this component is not set, no width is specified for the component table.

- `defaultRequiredAnnotationLocation` - Specifies the default location (left, right, or none) with respect to the component to render the required annotation. Identity Manager consults this property if the `requiredMarkerLocation` property has not been explicitly set on the `EditForm`. Defaults to right.
- `evenRowClass` - Specifies the CSS class to use to style the even rows of the `EditForm` table (if the `noAlternatingRowColors` property is not set to `true`). Defaults to `formevenrow`.
- `helpIcon` - Specifies the icon to render for flyover help messages for components. Defaults to `images/helpi_gold.gif`.
- `noAlternatingRowColors` – Specifies whether rows in the EditForm are rendered in the same color. When `noAlternatingRowColors` is set to true, every row in the EditForm is rendered the same color. If not specified, this defaults to `false`.
- `oddRowClass` - Specifies the CSS class to use to style the odd rows of the `EditForm` table (if the `noAlternatingRowColors` property is not set to `true`). Defaults to `formoddrow`.
- `requiredAnnotation` - Specifies the annotation to render next to a required field. This defaults to an image of a red asterisk.
- `requiredClass` - Specifies the CSS class to use to style the required field legend. Defaults to `errortxt`.
- `requiredLegendLocation` - Specifies the location (top or bottom) at which to render the required legend if the form contains any required fields. Defaults to bottom.
- `rowPolarity` - Specifies the polarity of alternating gray and white row colors in a table. The default is `true`. A value of `false` inverts the polarity and gives the first form field a white background. The code shown in the following example results in a table whose first form field has a white background.

```
<Display class='EditForm'>
  <Property name='componentTableWidth' value='100%'/>
  <Property name='rowPolarity' value='false'/>
  <Property name='requiredMarkerLocation' value='left'/>
  <Property name='messages'>
    <ref>msgList</ref>
  </Property>
</Display>
```

- `tableClass` - Specifies the CSS class to use to style the table that contains the `EditForm` component.
- `tableWidth` - Specifies the width in pixels of the table in which Identity Manager renders the `EditForm` component. Defaults to 400.
- `titleClass` - Specifies the CSS class to use to style help messages for components.

Menu

Consists of three classes: `Menu`, `MenuBar`, and `MenuItem`.

- `Menu` refers to the entire component.
- `MenuItem` is a leaf, or node, that corresponds to a tab on the first or second level.
- `MenuBar` corresponds to a tab that contains `MenuBars`, or `MenuItems`.

`Menu` contains the following properties:

- `layout` - A String with value `horizontal` or `vertical`. A value of `horizontal` generates a horizontal navigation bar with tabs. A value of `vertical` causes the menu to be rendered as a vertical tree menu with typical node layout.
- `stylePrefix` - String prefix for the CSS class name. For the Identity Manager End User pages, this value is `User`.

`MenuBar` contains the following properties:

- `default` - A String URL path that corresponds to one of the MenuBar's MenuItem URL properties. This controls which subtab is displayed as `selected` by default when the `MenuBar` tab is clicked.

`MenuItem` contains the following properties:

- `containedUrls` - A List of URL path(s) to JSPs that are "related" to the MenuItem. The current MenuItem will be rendered as "selected" if any of the `containedUrls` JSPs are rendered. An example is the request launch results page that is displayed after a workflow is launched from the request launch page.

You can set these properties on either a `MenuBar` or `MenuItem`:

- `title` - Specifies the text String displayed in the tab or tree leaf as a hyperlink
- `URL` - Specifies the String URL path for the title hyperlink

The following XPRESS example creates a menu with two tabs. The second tab contain two subtabs:

Code Example 6-1 Implementation of Menu, MenuItem, and MenuBar Components

```
<Display class='Menu'/>
<Field>
   <Display class='MenuItem'>
     <Property name='URL' value='user/main.jsp'/>
     <Property name='title' value='Home' />
   </Display>
</Field>
<Field>
    <Display class='MenuBar' >
      <Property name='title' value='Work Items' />
     <Property name='URL' value='user/workItemListExt.jsp' />
   </Display>
    <Field>
       <Display class='MenuItem'>
         <Property name='URL' value='user/workItemListExt.jsp'/>
         <Property name='title' value='Approvals' />
        </Display>
     </Field>
    <Field>
      <Display class='MenuItem'>
         <Property name='URL' value='user/otherWorkItems/listOtherWorkItems.jsp'/>
          <Property name='title' value='Other' />
       </Display>
    </Field>
 </Field>
```

In the Identity Manager User Interface, the horizontal navigation bar is driven by the End User Navigation User form in `enduser.xml`.

The `userHeader.jsp`, which is included in all Identity Manager User Interface pages, includes another JSP named `menuStart.jsp`. This JSP accesses two system configuration objects:

- `ui.web.user.showMenu` - Toggles the display of the navigation menu on/off (default is `true`).
- `ui.web.user.menuLayout` - Determines whether the menu is rendered as a horizontal navigation bar with tabs (the default value is `horizontal`) or a vertical tree menu (`vertical`).

`style.css` contains the CSS style classes that determine how the menu is rendered.

Panel

Defines the most basic container. Panel renders its children in a simple linear list.

Properties include:

- `horizontal` – Aligns components horizontally, when set to `true`. (Boolean)
- `horizontalPad` – Specifies the number of pixels to use for the cell padding attribute of the table surrounding horizontal components.
- `verticalPad` – Specifies the number of blank lines added between components. (Boolean)

The default orientation is vertical, but can be set to horizontal.

Selector

Provides a single- or multi- valued field (similar to Text or ListEditor components, respectively) with search fields below. After a search is executed, Identity Manager displays results beneath the search fields and populates the results into the value field.

Unlike other container components, `Selector` has a value (the field we are populating with `search` results). The contained fields are typically search criteria fields. `Selector` implements a property to display the contents of the search results.

Properties include:

- `fixedWidth` – Specifies whether the component should have a fixed width (same behavior as Multiselect). (Boolean)
- `multivalued` – Indicates whether the value is a List or a String. (The value of this property determines whether a ListEditor or Text field is rendered for the value). (Boolean)
- `allowTextEntry` – Indicates whether values must be selected from the supplied list or can be entered manually. (Boolean)
- `valueTitle` – Specifies the label to use on the `value` component. (String)
- `pickListTitle` – Specifies the label to use on the `picklist` component. (String)
- `pickValues` – the available values in the picklist component (if null, the picklist is not shown). (List)
- `pickValueMap` – a map of display labels for the values in the picklist. (Map or List)

- `searchLabel`– Labels the button next to the input text field with the supplied text. If not set, the text defaults to "...".
- `sorted` – Indicates that the values should be sorted in the picklist (if multivalued and not ordered, the value list will also be sorted). (Boolean)
- `clearFields` – Lists the fields that should be reset when the Clear button is selected. (List)

The following properties are valid only in a multi-valued component:

- `ordered` – Indicates that the order of values is important. (Boolean)
- `allowDuplicates` – Indicates whether the value list can contain duplicates. (Boolean)
- `valueMap` – Provides a map of display labels for the values in the list. (Map)

These properties are valid only in a single-valued component:

- `nullLabel` – Specifies a label to use to indicate a value of null. (String)

SimpleTable

Arranges components in a grid with an optional row of column titles at the top.

Properties include:

- `columns` – Defines the column headers. Usually a list of message keys, but can also be simple strings. (List)
- `rows` – Defines the cells of the table. Each cell must be a component. (List)
- `columnCount` – Specifies the number of columns if there is no column title list.
- `border` – Determines the width of the table border. Set to 0 to create invisible borders.
- `noItemsMessage` – Specifies the message to display in the table when there are no rows.

TabPanel

Use to render a tabbed panel that displays a row of tabs as shown below. By default, the tabs are aligned horizontally.

Properties include:

- `leftTabs` – When set to `true`, aligns tabs along left margin, not along the top. (Boolean)

- `border` – Draws a border around the main panel under the tabs, when set to `true`. (Boolean)
- `renderTabsAsSelect` – Renders tabs as a Select drop-down rather than tabs, when set to `true`. This is useful when a form contains many tabs that would cause the browser to scroll horizontally. Do not use in conjunction with aligning the tabs on the left.
- `tabAlignment` – Determines the position of the tabs relative to the page content. Valid values include left (default setting), top, right, bottom, center, and middle.
- `validatePerTab` -- When set to true, Identity Manager performs validation expressions as soon as the user switches to a different tab.

```
<Field name='MainTabs'>
   <Display class='TabPanel'>
     <Property name='leftTabs' value='false'/>
     <Property name='tabAlignment' value='left'/>
</Field>
```

Row

Use to create a Panel capable of horizontal alignment.

SortingTable

Use to create a table whose contents can be sorted by column header.Child components determine the content of this table. Create one child component per column (defined by the `columns` property). Columns are typically contained within a FieldLoop.

This component respects the `align`, `valign`, and `width` properties of the children components when rendering the table cells.

Properties include:

- `emptyMessage` – Specifies the String or message key to display in the table when the table has no rows. If you omit this property, Identity Manager displays a generic message.
- `pageButtonAlign` – Determines position of buttons relative to page content. Valid values include left, right, bottom, and center. The default value is right.

- `sortEnable` – Enables column sorting when set to true. (Boolean)
- `sortURL` – Identifies the URL that Identity Manager posts to when column sorting is selected. If column sorting is not set, Identity Manager uses the `_postURL` of the HtmlPage. (String)
- `sortURLParams` – Specifies the parameters that get passed along with the `sortURL`. (String)
- `sortColumn` – Specifies the number of the column that we are currently sorting by. The default is to set this value to the first column. (Integer)
- `sortOrder` – Specifies the sort order. Values includes `asc` (for ascending) or `desc` (for descending). Default value is `asc`. (String)
- `linkEnable` – Indicates if this table is to be generated with the first column as links. (Boolean)
- `linkURL` – Specifies the URL that Identity Manager links to when generating links. If not specified, defaults to the post URL of the containing HtmlPage. (String)
- `linkURLArguments` – Indicates the arguments to include in the link URL.
- `linkColumn` – Specifies the column number that will be used for the generated links as specified by the `linkURL` attribute. (Integer)
- `linkParameter` – Specifies the name of the post data parameter that will have the value of the link row `id`. The default value is `id`.
- `selectEnable` – Indicates whether a column of checkboxes is displayed along a MultiSelect table's left margin. When set to `true`, Identity Manager displays a column of checkboxes. (Boolean)
- `columns` – Lists table column headers. (List of strings)
- `pageSize` – Specifies that the table should display at most `_pageSize` entries simultaneously. If more than `_pageSize` entries exist, then interface elements allow paging through the results. If `_pageSize` is less than 1 (the default setting), then all entries are displayed at once. (Integer)
- `useSavedPage` – If the value of `pageSize` exceeds 0, then the sorting table saves the current sorting table page on the HTTP session in the `<fieldName>_currentPage` attribute. The `_useSavedPage` property indicates whether the current page should be retrieved from the HTTP session and displayed. By making the value of this property the result of an XPRESS expression, the form or view can control when the current page is recalled after when returning back to the JSP containing the `SortingTable` component. (Boolean)

For example, if the `SortingTable` component displays the results of a query containing editable items, to ensure that Identity Manager displays the results page that contains the edited item after the user has edited an item in the result table, enter a value that exceeds 0.

WizardPanel

Use to render one of several child components (typically EditForms) that use wizard-style Next and Previous buttons to navigate between components.

Properties include:

- `button` – Specifies a value for child component's `location` property that will place it in the button row. (String)
- `nextLabel` – Specifies the label to display on the Next button. The default text is Next. (String)
- `prevLabel` – Specifies that the label in the Previous button is displayed. (String)
- `cancelLabel` – Specifies that the label in the Cancel button is displayed. (String)
- `okLabel` – Specifies that the label is displayed in the OK button. (String)
- `noOk` – Specifies that the OK button is not displayed. (Boolean)
- `alwaysOk` – Determines that the OK button is displayed, when set to `true`. (Boolean)
- `noCancel` – Specifies that the Cancel button is not displayed, when set to `true`. (Boolean)
- `topButtons` – Causes the buttons to be rendered at the top of the page rather than the page bottom, when set to `true`. (Boolean)
- `noButtons` – Suppresses all button rendering when set to `true`. (Boolean)

Component Subclasses

All components extend the `Component` class, which defines the properties common to most components. In addition, some components extend the `Container` class, which gives them the ability to contain other components.

Each `Component` subclass defines a number of *properties* that are used to specify the characteristics of the component beyond those implied by the Component base class. For example, the `Label` component supports a `font` property, which can be used to specify the font used when rendering the label.

Naming Conventions

Properties always begin with a lowercase letter and use camel case to separate adjacent words. Access method names are formed by capitalizing the property name, and prefixing either `get` or `set`. For example, the property named `font` is accessible from Java using the `getfont` and `setfont` methods.

The data type for each property varies and is documented with the property. the terminology used to describe property value types is described in the following table.

Data Types

This table lists the data types allowed in component properties.

Table 6-2 HTML Component Property Data Types

Type	Description
`null`	Indicates that a property has no value
`String`	Represents the most common data type. String values are usually represented by an instance of the Java `String` class. Some components are values of any class. These are implicitly coerced to strings with the `toString` method. Unless otherwise specified, you can assume that all properties are of type `string`. Example: `<String>Hello World</String>`

`List of string`	Indicates that the value is expected to be a list of one or more strings. In Java, this value is always implemented as an instance of the `List` class. The elements of the list are then expected to be instances of the `String` class.
	
	Example:
	
	`<List>`
	`<String>choice one</String>`
	`<String>choice two</String>`
	`</List>`

Base Component Class

The `Component` class is the base class for all HTML components. It contains the properties that are common to most components. Not all `Component` properties are relevant in every subclass. For example, `Component` defines a property `allowedValues` that can contain a list of value constraints. This property is relevant only in subclasses that allow value editing such as `Select` or `MultiSelect`. Further, `Container` classes almost never directly represent an editable value. Consequently, any properties related to the component value are irrelevant. Some properties are relevant only if the component is contained within a specific `Container` class.

name

Specifies the internal name of a field. All editing components must have a name, which is typically unique among all components displayed on the page. `name` is a string that is usually a path to a view attribute.

Container components do not require names and any assigned names are ignored. When building components from Java, component names are defined by the application. When building components from XML forms, component names are derived from the names of `Field` elements in the form. Field names are in turn *path expressions* within the view object that is used with the form.

Example

```
<Field name ='global.firstname'>
```

For more information on how the `name` attribute refers to a specific attribute in the user view, see Identity Manager Views.

title

(Optional) Specifies the external name of a field. Titles are typically used with the `EditForm` container, which builds an HTML table that contains titles in one column and components in another.

Components do not render their own titles. Rendering of titles is controlled by the container. Many containers ignore titles.

Example

```
<Property name='title' value='FirstName'/>
<Property name='title'>
   <expression>
      <concat>
         <s>Edit User: </s>
         <ref>waveset.accountId</ref>
      </concat>
   </expression>
</Property>
```

In this example, the field title is in part derived dynamically from the user's Identity Manager account ID.

value

Editing components have a value that may be null. The value is typically set automatically by Identity Manager from an attribute in a view. Some components allow you to set the value by explicitly ignoring current view content. This value can be null.

The `Component` class allows the value to be any Java object. The subclass must coerce the value to a particular type when it is assigned, or when the HTML is generated. Component values are almost always `String` objects or `List` objects that contain strings. See the section titled Data Types for more information on component value types.

Most container classes do not have values. If you assign a value, it is ignored. Some containers do allow values (for example, `TabPanel` and `WizardPanel`).

When building components from XML forms, the value is usually derived by using the component `name` as a path into the underlying view object, which contains all the values being edited.

Example

```
<Property name= 'value' value='false '/>
```

allowedValues

Specifies an optional list of allowed values for the component. If specified, the component allows you to select from only values that are on the list. If the component supports value restrictions, the list of allowed values is stored here. The value is always a list and usually contains strings. For convenience when setting properties from XML forms, you can also specify the allowed values as a comma list.

Example

```
<Property name='allowedValues' value= 'Mon, Tue, Wed, Thurs, Fri'/>
<Property name='allowedValues'/>
   <expression>
      <call name='DaysoftheWeek'/>
   </expression>
</Property>
```

primaryKey

This property is recognized only by the `SortingTable` container. The `SortingTable` container organizes components into a table with each column expected to contain components of the same class. `SortingTable` allows the rows to be sorted according to the values in any column. Typically, the sort order is determined from the `value` of each component in the column. There may be cases, however, where the value of the component is not suitable for sorting or may be inefficient to compare. In these cases, you can specify an alternate numeric sorting key.

required

If `true`, indicates that the field is expected to have a value before the form is submitted. If the component is contained within an `EditForm`, a red * (asterisk) will be placed after the component to indicate that the user must enter a value before saving. If the required schema map attribute is selected, (that is, set to a value of `true)`, the field is always required.

The value of the property must be either `true` or `false`.

Example

```
<Property name='required ' value='true '/>
```

noNewRow

If `true`, the field displays on the Identity Manager page next to the previous field. If not specified or set to `false`, the field appears on a new line, directly under the previous field. The default value is `false`

This Boolean property is recognized only if the field is contained in a form that uses the `EditForm` display class. Typically, `EditForm` renders each component on a new row with the titles aligned in the left column and the component in the right column. To conserve space, you can concatenate several components on the same row. If the component also has a title, the title is rendered as non-highlighted text between the previous component and this component.

Values include:

```
value='true ' | 'false '
```

Example

```
<Property name='noNewRow ' value='true '/>
```

location

Use if the container defines more than one display area and the component must be added to a specific area. Some containers allow the placement of components to be controlled by assigning a value to the `location` property. For example, the `BorderedPanel` container supports five different display areas: north, south, east, west, and center.

The recognized values for the `location` property are defined by the container. If you do not assign a location, or assign a location name that is not recognized, the container places the component in the default location.

help

Specifies text that may be displayed to assist the user in understanding purpose of the field. In most Identity Manager pages, this will cause the `<icon>` icon to be displayed next to the component title. Moving the mouse over this icon will cause the help text to be displayed in the left margin.

The value of the property can either be literal text to be displayed, or it can be a message catalog key. Literal text can include HTML markup.

For more information on adding help to your custom form, see "Adding Guidance Help to Your Form" on page 168.

inlineHelp

Specifies the text that can be rendered beneath a component in Identity Manager pages.

The value of the property can either be literal text to be displayed, or it can be a message catalog key. Literal text can include HTML markup.

command

Specifies a command to submit when a component is modified. (When a user makes a change to a value, form output is recalculated.)

This property is typically used with the `Button` component. Some components must cause immediate submission of the surrounding HTML form when they are modified so that the application can regenerate the page based on that modification. Setting the `command` property to a non-null value causes this behavior.

When the `command` property is set, and the component is modified, the form is posted and an extra hidden parameter named `command` is posted whose value is the value of the `command` property.

The command specifies how the system will process the edits that have been made to a view. The `command` property must have one of the following values.

Table 6-3 Values of command Property

Value	Description
Save	Causes the edits to be saved.
Cancel	Causes the edits to be discarded.
Recalculate	Causes the page to be regenerated.
SaveNoValidate	Causes the edits to be saved, but no form validation to be performed.

Because specifying a command value of `Recalculate` is so common in forms, an shorter alterative syntax is available. The `Display` element has an attribute named `action` that when set to true, has the same effect as setting the `command` property to **Recalculate**.

```
<Display class='Select' action='true'>"
```

onClick

When specified, the value is expected to contain JavaScript that will be assigned as the value of the `onClick` attribute of the `input` element generated for this component. Not all components support the `onClick` property.

Use of this property is rare and requires detailed knowledge of the generated HTML. If you use this property, the page must typically contain a `Javascript` component that defines JavaScript functions you call from within the `onClick` value.

Example

```
<Property name='onClick' value="Uncheck(this.form,
'resourceAccounts.selectAll');"/>
```

NOTE Once forms are stored in the repository, Identity Manager always uses single quotes to surround attribute values. If single quotes appear within the attribute value, they will be replaced with '. To prevent this escaping you can represent the string in an XPRESS `s` expression:

```
<Property name='onClick'>
   <s>Uncheck(this.form, 'resourceAccounts.selectAll'); </s>
</Property>"
```

onChange

Similar to `command`. The value can be an arbitrary JavaScript statement to run when the field is modified.

Not all components support the `onChange` property.

Use of this property is rare and requires detailed knowledge of the generated HTML. If you use this property, the page must typically contain a `Javascript` component that defines JavaScript functions you call from within the `onChange` value.

nowrap, align, width, valign, and colspan

Most containers position subcomponents by surrounding them with an HTML `table` tag. The HTML generated for each component then is typically contained in a `td` tag. Some containers can recognize the `nowrap`, `align`, `width`, and `colspan` properties and use them when generating the surrounding table cell tag. You can use these components to adjust the position and size of the component within the container.

- `nowrap` – Specifies how some components are displayed if they contain a long string of text. If the value of `nowrap` is false or unspecified, the browser can break up the component text into multiple lines when it is displayed. If the value of `noWrap` is true, the browser will try to keep the component text on a single line.
- `align` – Rarely used. Adjusts the element horizontally on the form. Allowed values are left, right, and center.
- `valign` – Rarely used. Specifies where components are rendered vertically. Allowed values are top, bottom, and middle.
- `colspan` – Deprecated

Example

```
<Property name= 'width' value='3'/>

<Field name='Start Day' prompt='Day' nowrap='true'/>
```

htmlFormName

Allows you to set the name attribute of the HTML `<FORM>` tag in which the component will be rendered. This ensures that JavaScript functions used by the component reference the desired HTML form. Because the default value is `mainform`, this property is useful only if the component is to be rendered in a form other than `mainform`.

Example

```
<Property name='htmlFormName' value='endUserNavigation'>
```

Basic Components

BackLink

Displays a link that returns to the previous page. The behavior of this component is the same as that of the browser **Back** button. However, you may want to place this link in a convenient position on the page.

Properties for this display component:

- `text` – Specifies the text of the link. If you do not specify text, the link defaults to **Back**.

Example

```
<Field name='back'>

   <Display class='BackLink'>

      <Property name='value' value='previous page'/>

   </Display>

</Field>
```

Button

Displays a button. Buttons typically submit the surrounding form, but they can also be defined to run arbitrary JavaScript.

Properties for this display component are:

- `class` - Specifies the CSS class to use for an enabled button. Defaults to `formbutton`.
- `command` – Specifies an optional value to submit along with the `name` parameter (for example, Save, Cancel, Recalculate).
- `disabledclass` - Specifies the CSS class to use for a disabled button. Defaults to `formbutton`.
- `hiddenID` – Specifies an optional value for an *id* parameter to be included in the form post data.
- `label` – Specifies the visible text that displays on the button.
- `linkClass` - Specifies the CSS class to use when a button is rendered as a link.
- `name` – Specifies the name of the parameter that will be posted when the user clicks this button. This property is optional; if not specified, the default value is `command`.
- `onMouseOver` - Contains the Javascript to execute on an `onMouseOver` event for the button. You can use this property to change the style of the button when mousing over it.
- `onMouseOut` - Contains the Javascript to execute on an `onMouseOut` event for the button. You can use this property to change the style of the button when moving the mouse off it.
- `onFocus` - Contains the Javascript to execute on an onFocus event for the button. You can use this property to change the style of the button when the button is focused.
- `onBlur` - Contains the Javascript to execute on an onFocus event for the button. You can use this property to change the style of the button when the button loses focus.
- `postURL` – Specifies an alternate, target URL to which the form will be posted. This value overrides the URL specified in the JSP.
- `value` – Specifies the value of the parameter posted when the user clicks this button.

Example

```
<Display class ='Button'>
   <Property name ='label' value ='Change Password'/>
   <Property name ='value' value ='Recalculate'/>
</Display>
```

Checkbox

Displays a checkbox. When selected, the box represents a value of `true`. An unselected box represents a `false` value.

Properties for this display component are:

- `label` – (Optional) Specifies a label that is displayed to the right of the checkbox. It is displayed adjacent to the component, but is not displayed in the title column
- `leftLabel` – Specifies that the label should appear to the left of the checkbox.
- `checkAll` – Set when this checkbox is serving as a Select All checkbox, which should then propagate its value to a set of other checkboxes. The value of the property is a regular expression that is used to match the names of other checkboxes on the HTML page.
- `uncheck` – Set to the name of another checkbox field that represents the Select All checkbox in a collection of synchronized checkboxes. If this is set, whenever the selected status of this checkbox is changed, the Select All checkbox is unselected.
- `syncCheck` – Set to the name of another checkbox field that must stay in sync with the value of the checkbox field on which this property is set. If this is set, whenever the value of this checkbox is changed, the sync'ed checkbox's value is set to the same value.
- `syncUncheck` – Set to the name of another checkbox field that should stay in sync when the value of the checkbox field on which this property is set is changed to `false`. If this is set, whenever the value of this checkbox is changed to `false`, the synchronized checkbox's value will also be set to `false` (unselected).
- `syncCheckAllTo` – Indicates that all Select All checkboxes matching the regular expression will be kept in sync with the value of the checkbox field on which this property is set when its value is changed to `false`. The value of this property is a regular expression that represents one or more of the Select All checkboxes.
- `syncUncheckAll` – Set to the name of another checkbox field that should stay in sync when the value of the checkbox field on which this property is set is changed to `false`. If this is set, whenever the value of this checkbox is changed to `false`, the synchronized checkbox's value will also be set to `false` (unselected).

- `syncCheckTo` – Indicates that all checkboxes matching the regular expression will be kept in sync with the value of the checkbox field on which this property is set. Whenever the value of the checkbox field on which this property is set is changed, the sync'ed checkbox's value will be set to the same value. The value of the property is a regular expression.
- `value` – Determines the state of the checkbox. If the value is logically true, the checkmark appears.

Example

```
<Field name='accounts[AD].passwordExpired'>
   <Display class='Checkbox'>
      <Property name='title 'value='Password is Expired'/>
   </Display>
</Field>
```

DatePicker

Allows the user to specify a date using a pop-up window that displays a calendar. Identity Manager displays the field in the form as a calendar icon. When a user clicks on the icon, Identity Manager opens the calendar in a separate pop-up window.

This component allows a user to enter a date value. Depending on how you set the component properties, the user can enter a date value using select menus, a text field, or a calendar pop-up window. By default, the component renders with a text field and an icon that you click to bring up the calendar pop-up.

Properties include:

- `command` – Specifies an optional value to submit (for example, Save, Cancel, or Recalculate). Setting this property to Recalculate has the same effect as setting the `action` property to `true`, which triggers a refresh (or other) operation. You can trigger a refresh operation by either:
  - Selecting the date with the date widget

    or
  - Changing the date in the text area and tabbing to or clicking another screen area for the refresh to occur.

  See the discussion of the `command` property in *Base Component Class* for more information.

- `disableTextInput` – (Boolean) When set to `true`, the component renders the date text string without the text input box. Without a text input box, a user cannot edit this field. To change the value of the date string, the user must click the calendar icon and select a date using the pop-up window. Identity Manager displays the newly selected date as plain text next to the calendar icon.

  If this property is not present, or if set to `false`, the component renders the input text field normally.

- `displayFormatHint` – Determines whether the component presents a hint of the expected date format to be entered in the text field. When set to `true`, Identity Manager renders a "hint" of the expected date format. The value of the format string is determined by the component's `format` property. Identity Manager does not present a hint under these circumstances:

  - this property is set to `false`
  - this property is missing
  - `multiField` property is set to `true`
  - `disableTextInput` is `true`.

- `format` – Specifies the date format to use for displaying the date. This can be a Java-style date formatting string that uses any of the following formatting characters: `y`, `M`, or `d`. This can also be the value `iso`, specifying ISO format (yyyy-MM-dd), or the value `local`, specifying a locale-sensitive format (the Java default for the locale). If omitted, Identity Manager uses the format "MM/dd/yyyy".

- `multiField` – Indicates whether separate input fields should be displayed for each element of the date. If omitted or false, Identity Manager uses a single text field for input, expecting properly formatted date text.

- `value` – Specifies the date to be highlighted on the calendar as the current date. Date can be parsed from either a `Date` object or a `String` object.

Example

```
<Field name='ExpireDate'>
   <Display class='DatePicker'>
      <Property name='title' value='Set Password Expire  date'/>
      <Property name='format'= value='iso'/>
   </Display>
</Field>
```

FileUpload

Displays a text field and a **Browse** button that allows the user to select a file and upload it to the server. Use this component to import data into Identity Manager from a file (such as users or configuration objects). This component supports all the properties that the `Text` component supports.

Html

Allows you to insert arbitrary HTML markup into a form field or other component contained within an HTML page, including JavaScript.

This component contains one property: `html`, which allows you to specify the string(s) that are rendered into the page.

Example

```
<Display class='Html'>
   <Property name='html'>
       <concat>
         <s><![CDATA[<div class="DashAlrtMsgTxt">]]></s>
         <ref>loginWarning</ref>
         <s><![CDATA[ <a href=']]></s>
         <s>user/changePassword.jsp</s>
         <s><![CDATA['>]]></s>
         <message name='UI_USER_MAIN_CLICK_HERE_INTRO'/>
         <s><![CDATA[</a>]]></s>
         <message name='UI_USER_MAIN_CLICK_HERE_REMAINDER'/>
         <s><![CDATA[</div>]]></s>
       </concat>
   </Property>
</Display>
```

HtmlPage

Describes the root HTML page. This component can contain arbitrary HTML and browser JavaScript. Properties include:

- `commentScripts` – Indicates whether `<script>` tags emitted for JavaScript should be enclosed in comments.
- `title` – Specifies the title of the page. Can be a String or Message, but typically is a String.
- `postUrl` – Specifies the URL that Identity Manager posts to when the main form is submitted.

- `messages` – Indicates which informational messages to display.
- `comments` – Indicates the special comments to include. This property is typically used by GenericEditForm and FormConverter when these methods catch exceptions.
- `focussedFieldName` – Specifies the name of the first field to receive focus. Typically null. The value of this property is calculated as the first text field, or if no text fields, the first field.
- `activeControl` – Specifies the name of the last known active form field. (String)

InlineAlert

Displays an error, warning, success, or informative alert box. This component is typically located at the top of a page. You can display multiple alerts in a single alert box by defining child components of type `InlineAlert$AlertItem`.

Properties for this display component include:

- `alertType` – Specifies the type of alert to display. This property determines the styles and images to use. Valid values are error, warning, success, and info. The value of this property defaults to info. This property is valid only for `InlineAlert`.
- `header` – Specifies the title to display for the alert box. This can be either a string or a message object. This property is valid for `InlineAlert` or `InlineAlert$AlertItem`.
- `value` – Specifies the alert message to display. This value can either be a string or a message object. This property is valid for `InlineAlert` or `InlineAlert$AlertItem`.
- `linkURL` – Specifies an optional URL to display at the bottom of the alert. This property is valid for `InlineAlert` or `InlineAlert$AlertItem`.
- `linkText` – Specifies the text for the `linkURL`. This can be either a string or a message object. This property is valid for `InlineAlert` or `InlineAlert$AlertItem`.
- `linkTitle` – Specifies the title for the `linkURL`. This can be either a string or a message object. This property is valid for `InlineAlert` or `InlineAlert$AlertItem`.

Example of Single Alert Message

```
<Field>
   <Display class='InlineAlert'>
      <Property name='alertType' value='warning'/>
      <Property name='header' value='Data not Saved'/>
      <Property name='value' value='The data entered is not yet saved.
Please click Save to save the information.'/>
   </Display>
</Field>
```

Example of Multiple Alert Messages

Define `alertType` only within the `InlineAlert` property. You can define other properties in the `InlineAlert$AlertItems`.

```
<Field>
   <Display class='InlineAlert'>
      <Property name='alertType' value='error'/>
   </Display>
   <Field>
     <Display class='InlineAlert$AlertItem'>
        <Property name='header' value='Server Unreachable'/>
        <Property name='value' value='The specified server could not
       be contacted.  Please view the logs for more information.'/>

        <Property name='linkURL' value='viewLogs.jsp'/>
        <Property name='linkText' value='View logs'/>
        <Property name='linkTitle' value='Open a new window with
           the server logs'/>

     </Display>
  </Field>
  <Field>
     <Display class='InlineAlert$AlertItem'>
        <Property name='header' value='Invalid IP Address'/>
        <Property name='value' value='The IP address entered is in an
invalid subnet.  Please use the 192.168.0.x subnet.'/>
      </Display>
  </Field>
</Field>
```

Javascript

Use to insert pre-formatted JavaScript into the page. This is useful if you are using the `onClick` or `onChange` properties in components and want to call custom JavaScript functions.

Though not required, consider specifying the `name` property when building components from XML forms. Using features such as field loops and field inclusion, you can add more than one JavaScript component containing the same script to the page. During HTML generation, JavaScript components that have the same name are included only once.

Example

```
<Display class='Javascript'>
 <Property name='script'>
 <String>
function setTextFromSelect(sel, textFieldName) {
 if ( sel == null || sel.inchange ) return;
 sel.inchange = true;
 var textField = sel.form.elements[textFieldName];
 if ( textField == null ) return;
 textField.value = sel.value;
 sel.selectedIndex = 0;
 sel.inchange = false;
}  // setTextFromSelect(sel, textFieldName)
 </String>
 </Property>
 <Property name='noNewRow' value='true'/>
 </Display>
```

The component has an extended property named `script` that can contain the JavaScript text.

Label

Displays a string of text.

Properties for this display component are:

- `value` – Defines the text to be displayed. The value can be either a string or a list of strings. When the value is a list, each string in the list is displayed on a separate line.
- `leftPad` – Specifies the number of spaces to insert to the left of the label.
- `pad` – Specifies the number of spaces to insert to the left and right of the label.
- `rightPad` – Specifies the number of spaces to insert to the right of the label.

NOTE If no padding is specified, the default padding is leftPad=2, rightPad=2.

```
<Field>
   <Display class='Label'>
      <Property name='title' value='Account ID'/>
      <Property name='value'>
         <ref>waveset.accountId,/ref>
      </Property>
   </Display>
</Field>
```

- `font` – Specifies the font style. The value must be one of the styles defined in the styles/style.css file of the Identity Manager installation directory.
- `color` – Specifies the label color. Use standard HTML color formatting (#*xxxxxx*) to specify the color value.

Link

Places a link on the page.

Properties include:

- `URL` – Specifies the target Uniform Resource Locator (URL).
- `imageURL` – (Optional) Specifies the URL to an icon or image that will be rendered to the right of the link.
- `imageURL2` – (Optional) Specifies the URL to an icon or image used will be rendered to the right of the first image.
- `hoverText` – Specifies text to display when the mouse rests over the first or second image.
- `id` – (Optional) Specifies a value to be included as the *id* query argument in the link.
- `arguments` – (Optional) Specifies a set of name/value pairs to be included as query arguments.
- `extraURL` – (Optional) Specifies an additional URL fragment to be included after the base URL and arguments.
- `baseURLOption` – (Optional) Specifies the prefix of the generated URL. This setting overrides the baseURL RequestState setting in cases where a different base URL is needed.

Example

```
<Field>
   <Display class='Link'>
      <Property name='name' value='Request
            Group Access'/>
      <Property name='URL'
         value='user/processLaunch.jsp?newView=true'>
      <Property name='id' value='Group Request
            Process'/>
   </Display>
</Field>
```

NOTE Link components are one place in your form where you might use a <map> element to pass name/value pairs. In the following example, the <map> element contains several pairs: a mapping of a String to a Boolean value and a String to a List.

```
<invoke class='com.waveset.ui.FormUtil'
name='getOrganizationsDisplayNames'>
   <ref>:display.session</ref>
     <map>
       <s>filterVirtual</s>
       <o><Boolean>true</Boolean></o>
       <s>current</s>
       <list>
         <ref>original.orgParentName</ref>
       </list>
       <s>excluded</s>
       <list><ref>orgName</ref></list>
     </map>
</invoke>
```

LinkForm

Renders a bulleted list of links, resembling a menu.

ListEditor

Renders an editable list of strings.

Properties

Properties include:

- `listTitle` - (String) Specifies the label that Identity Manager places next to the ListEditor graphical representation.
- `pickListTitle` - (String) Specifies the label to use on the `picklist` component.
- `valueMap` - (Map) Specifies a map of display labels for the values in the list.
- `allowDuplicates` - (Boolean) A value of `true` indicates that Identity Manager allows duplicates in the managed list.
- `allowTextEntry` - (Boolean) A value of `true` indicates that Identity Manager displays a text entry box, along with an add button.
- `fixedWidth` - (Boolean) A value of `true` indicates that the component should be of fixed width (same behavior as `Multiselect` component).
- `ordered` - (Boolean) A value of `true` indicates that the order of values is important.
- `sorted` - (Boolean) A value of `true` indicates that the values should be sorted in the pick list. If values are multivalued and not ordered, Identity Manager also sorts the value list.
- `pickValueMap` - (List or Map) Specifies a map of display labels for the values in the pick list.
- `pickValues` - (List) Specifies the available values in the `picklist` component. If null, the `picklist` is not shown.
- `height` - (Integer) Specifiies preferred height.
- `width` - (Integer) Specifies the preferred width. Can be used by the Container as a property of the table cell in which this item is rendered.

Example

The following example shows a field that uses the ListEditor display class (Tabbed User Form):

```
<Field name='accounts[Sim1].Group'>
     <Display class='ListEditor' action='true'>
        <Property name='listTitle' value='stuff'/>
        <Property name='allowTextEntry'>
            <Boolean>true</Boolean>
        </Property>
        <Property name='ordered'>
            <Boolean>true</Boolean>
        </Property>
     </Display>
     <Expansion>
         <ref>accounts[Sim1].Group</ref>
     </Expansion>
</Field>
```

This code snippet creates a field where the customer can add groups to or remove them from a user.

NOTE This display class typically requires a List of Strings as input. To coerce a single String into a List of Strings:

```
<Expansion>
   <appendAll><ref>accounts[Sim1].Group</ref></appendAll>
</Expansion>
```

NameValueTable

A component that renders a collection of name/value pairs in a simple two column table. This component directly renders the data it contains.

Data can be specified in several forms:

- flat list – The list is expected to contain name/value pairs such that element 0 is a name, element 1 is a value, element 2 is a name.
- map – The entries in the map are emitted in alphabetical order.
- GenericObject – The object is flattened to and emitted as a map.

Properties include `_hideEmptyRows`, which when set to `true`, hides rows for which no value exists.

MultiSelect

Displays a multiselection text box, which displays as a two-part object in which a defined set of values in one box can be moved to a selected box. Values in the left box are defined by the `allowedValues` property, values are often obtained dynamically by calling a Java method such as `FormUtil.getResources`. The values displayed in the right side of a multiselection box are populated from the current value of the associated view attribute, which is identified through the field name.

The form titles for this two-part object are set through the `availabletitle` and `selectedtitle` properties.

If you want a `MultiSelect` component that does not use an applet, set the `noApplet` property to true.

See "Alternative to the MultiSelect Component" on page 501 for a related discussion.

NOTE If you are running Identity Manager on a system running the Safari browser, you must customize all forms containing MultiSelect components to set the `noApplet` option. Set this option as follows:

```
<Display class='MultiSelect'>
      <Property name='noApplet' value='true'/>
 ...
```

Properties for this display component are:

- `allowedValues` – Specifies the values associated with the left side of the multiselection box. This value must be a list of strings. **Note**: The `<Constraints>` element can be used to populate this box, but its use is deprecated.
- `availableTitle` – Specifies the title of the available box.
- `class` - Specifies the CSS class to use to style the `MultiSelect` buttons when the component is not rendered as an applet. Defaults to `formbutton`.
- `disabledclass` - Specifies the CSS class to use to style the disabled `MultiSelect` buttons when the component not rendered as an applet. Defaults to `formbutton`.
- `displayCase`– Maps each of the `allowedValues` to their uppercase or lowercase equivalents. Takes one of these two values: upper and lower.
- `height` – Specifies the width of the selected box in pixels. The default value is 400.
- `noApplet` – Specifies whether the MultiSelect component will be implemented with an applet or with a pair of standard HTML select boxes. The default is to use an applet, which is better able to handle long lists of values. See preceding note for information on using this option on systems running the Safari browser.
- `onBlur` - Javascript to execute on an onFocus event for the multiselect buttons. You can use this property to change the style of the button when the button loses focus.
- `onFocus` - Contains the Javascript to execute on an onFocus event for the `MultiSelect` buttons. This can be used to change the style of the button when the button is focused.
- `onMouseOver` - Contains the Javascript to execute on an `onMouseOver` event for the `MultiSelect` buttons. You can use this property to change the style of the button when mousing over it.
- `onMouseOut` - Contains the Javascript to execute on an `onMouseOut` event for the `MultiSelect` buttons. You can use this property to change the style of the button when moving the mouse off it.
- `ordered` – Defines whether selected items can be moved up or down within the list of items in the text box. A `true` value indicates that additional buttons will be rendered to permit selected items to be moved up or down.
- `selectedTitle` – Specifies the title of the selected box.

- `sorted` – Specifies that the values in both boxes will be sorted alphabetically.
- `typeSelectThreshold` – (Available only when the `noApplet` property is set to true.) Controls whether a type-ahead select box appears under the `allowedValue` list. When the number of entries in the left select box reaches the threshold defined by this property, an additional text entry field appears under the select box. As you type characters into this text field, the select box will scroll to display the matching entry if one exists. For example, if you enter **w**, the select box scrolls to the first entry that begins with **w**.
- `width` – Specifies the width of the selected box in pixels. The default value is 150.

Example

```
<Field name='accounts[LDAP].LDAPDept' type='string'>
   <Display class='MultiSelect' action='true'>
      <Property name='title' value='LDAP Department'/>
   </Display>
   <Constraints>
      <o>
         <List>
             <String>Sales</String>
             <String>Marketing</String>
             <String>International Sales</String>
      </List>
      </o>
   </Constraints>
</Field>
```

Radio

Displays a horizontal list of one or more radio buttons. A user can select only one radio button at a time. If the component value is null or does not match any of the allowed values, no button is selected.

Properties for this display component are:

- `title` – Specifies the title for all radio buttons.
- `labels` – Specifies an alternate list of button labels. The `labels` list must be as long as the values in the `allowedValues` list. Alternate labels can be used in cases where the values are cryptic. For example, values can be letter codes such as H, M, and S, but you would use this property to identify button labels hours, minutes, and seconds.

- `allowedValues` – Specifies the value associated with each button. This value must be a list of strings.
- `value` – Specifies values for the buttons. This value accepts one string. If not set, then the values are the same as the labels.

Example

```
<Field name='attributes.accountLockExpiry.unit'>
   <Display class='Radio'>
     <Property name='noNewRow' value='true'/>
     <Property name='labels'>
        <List>
           <String>UI_TASKS_XML_SCHED_MINUTES</String>
           <String>UI_TASKS_XML_SCHED_HOURS</String>
           <String>UI_TASKS_XML_SCHED_DAYS</String>
           <String>UI_TASKS_XML_SCHED_WEEKS</String>
           <String>UI_TASKS_XML_SCHED_MONTHS</String>
        </List>
     </Property>
     <Property name='allowedValues'>
        <List>
           <String>minutes</String>
           <String>hours</String>
           <String>days</String>
           <String>weeks</String>
           <String>months</String>
        </List>
     </Property>
   </Display>
</Field>
```

SectionHead

Displays a new section heading defined by the value of the `text` property. It is an extension of the `Label` class that sets the `font` property to a style that results in large bold text. It also sets the `pad` property to zero to eliminate the default 2 space padding. Use it to break up long forms into sections separated by a prominent label.

The only property for this display component is `text`, which specifies the text to be displayed.

Example

```
<Field>
   <Display class='SectionHead'>
      <Property name='text' value ='Calculated Fields'/>
   </Display>
</Field>
```

Select

Displays a single-selection list box. Values for the list box must be supplied by the `allowedValues` property.

Properties for this display component are:

- `allowedValues` – Specifies the list of selectable values for display in the list box.
- `allowedOthers` – When set, specifies that initial values that were not on the `allowedValues` list should be tolerated and silently added to the list.
- `autoSelect` – When set to `true`, this property causes the first value in the `allowedValues` list to be automatically selected if the initial value for the field is null.
- `multiple` – When set to `true`, allows more than one value to be selected.
- `nullLabel` – Specifies the text that displays at the top of the list box when no value is selected.
- `optionGroupMap` – Allows the selector to render options in groups using the `<optgroup>` tag. Format the map such that the keys of the maps are the group labels, and the elements are lists of items to be selectable. (Values must be members of `allowedValues` in order to render.)
- `size` – (Optional) Specifies the maximum number of rows to display. If the number of rows exceeds this size, a scroll bar is added.
- `sorted` – When set to `true`, causes the values in the list to be sorted.
- `valueMap` – Maps raw values to displayed values.

The component supports the `command` and `onChange` properties.

Example

```
<Field name='city' type='string'>
   <Display class='Select'>
      <Property name='title' value='City'/>
      <Property name='allowedValues'>
         <List>
            <String>Austin</String>
            <String>Portland</String>
            <String>New York</String>
         </List>
      </Property>
   </Display>
</Field>
```

Text

Displays a regular text entry box.

Common properties for this display component are:

- `autocomplete` – Specifies whether browsers should offer to store the user's credentials on their computer. By default, this property is set to `off`, which prevents browers from storing this information.
- `size` – Specifies the number of characters that are visible in the text entry box. The box size is recalculated depending upon the length of the text in the box.
- `notrim` – Specifies whether text posted from the HTML form is trimmed. Set to `true` to not trim white space. To preserve white space, set this option.
- `noTranslate` – When set to true, causes values that are message keys to be display as-is, rather than substituted. (Default is false.)
- `maxLength` – Specifies the maximum length of the string that can be edited in the text box.
- `multiValued` – Displays text boxes with Add and Remove buttons to add and remove values, when set to `true`.
- `secret` – Displays ***** (asterisks) in the place of entered text. This option is most often used in password fields.
- `readOnly` – Displays read-only text. This text cannot be edited by the user. You might use this property if, for example, you want to display resource attribute information that an administrator needs to view when creating or editing user accounts.

- `submitOnEnter` – When this property is set and the `Text` field has focus, then when the user presses the Enter key, the form is submitted using the command that is specified in the property value. In the following example, the form is submitted exactly as though the user has clicked **Save**.

Example

```
<Field name='variables.identityID'>
   <Display class='Text'>
      <Property name='required'>
         <Boolean>true</Boolean>
      </Property>
      <Property name='title' value='Identity ID'/>
      <Property name='size' value='32'/>
      <Property name='maxLength' value='128'/>
      <Property name='submitOnEnter' value='Save'/>
   </Display>
</Field>
```

TextArea

Displays a multi-line text entry box.

Properties for this display component are:

- `rows` – Specifies the number of text area rows. (Integer)
- `columns` – Specifies the number of text area columns. (Integer)
- `readOnly` – Displays read-only text in the text entry box. When set to `true`, this component will not have a border. (Boolean)
- `format` – Set to control how `setValue()` behaves and determine the type of object returned by `getPostData()`. (String)
- `sorted` – Enables sorting of lines in the text area, when set to `true`. This feature is convenient when the area is used to display a list of selections, not free-form text. (Boolean)
- `noTrim` – Specifies whether text posted from the HTML form is trimmed. The default is to trim white space. To preserve white space, set this value to `true`.

Example

To display a text box with five visible rows that wraps after each 70 characters specify:

```
<Field name='Description'>
   <Display class='TextArea'>
     <Property name='rows' value='5'/>
     <Property name='columns' value='70'/>
   </Display>
</Field>
```

If the user enters text beyond the defined visible rows, the text area displays a scroll bar.

Alternative to the MultiSelect Component

It can be unwieldy to display many admin roles using the MultiSelect component (either the applet or HTML version). Identity Manager provides a more scalable way of displaying and managing admin roles: the `objectSelector` field template.

The Scalable Selection Library (in `sample/formlib.xml`) includes an example of using an `objectSelector` field template to search for admin role names that a user can select.

Code Example 6-2 Example of objectSelector Field Template

```
<Field name='scalableWaveset.adminRoles'>
  <FieldRef name='objectSelector'>
     <Property name='selectorTitle' value='_FM_ADMIN_ROLES'/>
     <Property name='selectorFieldName' value='waveset.adminRoles'/>
     <Property name='selectorObjectType' value='AdminRole'/>
     <Property name='selectorMultiValued' value='true'/>
     <Property name='selectorAllowManualEntry' value='true'/>
     <Property name='selectorFixedConditions'>
       <appendAll>
         <new class='com.waveset.object.AttributeCondition'>
           <s>hidden</s>
           <s>notEquals</s>
           <s>true</s>
         </new>
         <map>
           <s>onlyAssignedToCurrentSubject</s>
           <Boolean>true</Boolean>
         </map>
       </appendAll>
     </Property>
     <Property name='selectorFixedInclusions'>
       <appendAll>
         <ref>waveset.original.adminRoles</ref>
       </appendAll>
     </Property>
  </FieldRef>
</Field>
```

How to Use the objectSelector Example Code

1. From the Identity Manager IDE, open the Administrator Library UserForm object.
2. Add the following code to this form:

```
<Include>

   <ObjectRef type='UserForm' name='Scalable Selection Library'/>

</Include>
```

3. Select the `accounts[Lighthouse].adminRoles` field within the `AdministratorFields` field.
4. Replace the entire `accounts[Lighthouse].adminRoles` with the following reference:

   ```
   <FieldRef name='scalableWaveset.adminRoles'/>
   ```

5. Save the object.

When you subsequently edit a user and select the Security tab, Identity Manager displays the customized form. Clicking... opens the Selector component and exposes a search field. Use this field to search for admin roles that begin with a text string and set the value of the field to one or more values.

To restore the form, import `$WSHOME/sample/formlib.xml` from **Configure > Import Exchange File**.

See the Scalable Selection Library in `sample/formlib.xml` for other examples of using the `objectSelector` template to manage resources and roles in environments with many objects.

Appendix A

Form and Process Mappings

This appendix lists the forms and workflow processes used in Identity Manager and their corresponding system names.

Form Mappings

The following table shows each form's system name and the name by which it appears in the product interface.

The **Form Mappings** column lists the system name of the form.

The name listed in the **Form Name Mapped To** column is the name by which the form is identified in Identity Manager IDE and in the Debug page of Identity Manager.

Table A-1 Form System and Product Interface Names

System Name	Mapped to
accessApprovalList	Access Approval List
accessReviewAbortConfirmation	Access Review Abort Confirmation
accessReviewDeleteConfirmation	Access Review Delete Confirmation Form
accessReviewDashboard	Access Review Dashboard
accessReviewSummary	Access Review Summary
accessReviewDetail	Access Review Detail
accessScanDeleteConfirmation	Access Scan Delete Confirmation
accessScanForm	Access Scan Form
accessScanList	Access Scan List
accountOwnerSelection	Account Owner Selection Form

Table A-1 Form System and Product Interface Names

System Name	Mapped to
accountSelect	Select Accounts Form
activeSyncWizard	Resource Active Sync Wizard
anonymousUserMenu	Anonymous User Menu
auditPolicyDeleteConfirmation	Audit Policy Delete Confirmation Form
auditPolicyList	Audit Policy List
auditorViewUserComplianceForm	Auditor Tab
changeAnswers	Change User Answers Form
changeCapabilities	Change User Capabilities Form
changeMyPassword	Change My Password Form
changeOrgAuditPolicies	Change Organization Audit Policies Form
changePassword	Change User Password Form
changePasswordSelection	User Selection Form
changeUserAuditPolicies	Change User Audit Policies Form
complianceViolationSummaryForm	Compliance Violation Summary Form
conditionForm	Condition Dialog
confirmDeletes	Confirm Deletes
conflictViolationDetailsForm	Conflict Violation Details Form
complianceViolationSummaryForm	Compliance Violation Summary Form
LDAP ChangeLog ActiveSync Create Group Form	LDAP Create Group Form
LDAP ChangeLog ActiveSync Create Organization Form	LDAP Create Organization Form
LDAP ChangeLog ActiveSync Create Organizational Unit Form	LDAP Create Organizational Unit Form
LDAP ChangeLog ActiveSync Create Person Form	LDAP Create Person Form
LDAP ChangeLog ActiveSync Update Group Form	LDAP Update Group Form
LDAP ChangeLog ActiveSync Update Organization Form	LDAP Update Organization Form
LDAP ChangeLog ActiveSync Update Organizational Unit Form	LDAP Update Organizational Unit Form
LDAP ChangeLog ActiveSync Update Person Form	LDAP Update Person Form
LDAP Listener ActiveSync Create Group Form	LDAP Create Group Form

Table A-1 Form System and Product Interface Names

System Name	Mapped to
LDAP Listener ActiveSync Create Organization Form	LDAP Create Organization Form
LDAP Listener ActiveSync Create Organizational Unit Form	LDAP Create Organizational Unit Form
LDAP Listener ActiveSync Create Person Form	LDAP Create Person Form
LDAP Listener ActiveSync Update Group Form	LDAP Update Group Form
LDAP Listener ActiveSync Update Organization Form	LDAP Update Organization Form
LDAP Listener ActiveSync Update Organizational Unit Form	LDAP Update Organizational Unit Form
LDAP Listener ActiveSync Update Person Form	LDAP Update Person Form
NetWare NDS ActiveSync Create Group Form	NetWare NDS Create Group Form
NetWare NDS ActiveSync Create Organization Form	NetWare NDS Create Organization Form
NetWare NDS ActiveSync Create Organizational Unit Form	NetWare NDS Create Organizational Unit Form
NetWare NDS ActiveSync Create User Form	NetWare NDS Create User Form
NetWare NDS ActiveSync Update Group Form	NetWare NDS Update Group Form
NetWare NDS ActiveSync Update Organization Form	LDAP Update Organization Form
NetWare NDS ActiveSync Update Organizational Unit Form	NetWare NDS Update Organizational Unit Form
NetWare NDS ActiveSync Update User Form	NetWare NDS Update User Form
remediationList	Remediation List
UserEntitlementForm	userEntitlementForm
userEntitlementSummaryForm	UserEntitlement Summary Form
violationDetailForm	Violation Detail Form
Windows Active Directory ActiveSync Create Container Form	Windows Active Directory Create Container Form
Windows Active Directory ActiveSync Create Group Form	Windows Active Directory Create Group Form
Windows Active Directory ActiveSync Create Organizational Unit Form	Windows Active Directory Create Organizational Unit Form
Windows Active Directory ActiveSync Create User Form	Windows Active Directory Create User Form
Windows Active Directory ActiveSync Update Container Form	Windows Active Directory Update Container Form

Table A-1 Form System and Product Interface Names

System Name	Mapped to
Windows Active Directory ActiveSync Update Group Form	Windows Active Directory Update Group Form
Windows Active Directory ActiveSync Update Organizational Unit Form	Windows Active Directory Update Organizational Unit Form
Windows Active Directory ActiveSync Update User Form	Windows Active Directory Update User Form
accountOwnerSelection	Account Owner Selection Form
anonymousUserMenu	Anonymous User Menu
changeAnswers	Change User Answers Form
changeCapabilities	Change User Capabilities Form
changeMyPassword	Change My Password Form
changePassword	Change User Password Form
changePasswordSelection	User Selection Form
confirmDeletes	Confirm Deletes
deprovisionUser	Deprovision Form
disableUser	Disable Form
editArgument	Edit Argument
editChangeLog	Edit ChangeLog
editChangeLogConfiguration	Edit ChangeLog Configuration
editChangeLogPolicy	Edit ChangeLog Policy
editField	Edit Field
editForm	Edit Form
editRule	Edit Rule
enableUser	Enable Form
endUserAccessApprovalList	Access Approval List
endUserAnonymousEnrollment	End User Anonymous Enrollment Form
endUserAppMenu	End User Navigation
endUserChangePassword	Change Password Form
endUserForm	End User Form
endUserLaunchList	End User Launch List
endUserMenu	End User Menu

Table A-1 Form System and Product Interface Names

System Name	Mapped to
endUserOtherWorkItemList	End User Other Work Item List
endUserResetPassword	Reset User Password Form
endUserTaskList	End User Task List
endUserTaskResults	End User Task Results
endUserWorkItemEdit	End User Work Item Edit
endUserWorkItemList	End User Work Item List
endUserWorkItemListExt	End User Approvals List
findAccountOwner	Find Account Owner Form
findObjects	Find Objects Form
findReconciledAccount	Find Account Form
findReconciledAccountResults	Find Account Results Form
findUser	Find User Form
findUserResults	Find User Results Form
listForms	List Forms
listRules	List Rules
loadForm	Default User Form
loginChangeAnswers	Login Change User Answers Form
loginChangePassword	Expired Login Form
loginResetPassword	Reset User Password Form
lookupUserId	Lookup UserId
otherWorkItemList	Other Work Item List
renameUser	Rename User Form
reprovisionForm	Default User Form
resetPassword	Reset User Password Form
resetPasswordSelection	User Selection Form
selfDiscovery	Self Discovery
userForm	Tabbed User Form
viewUserForm	Tabbed View User Form
enableUser	Enable Form
endUserChangePassword	Change Password Form

Table A-1 Form System and Product Interface Names

System Name	Mapped to
endUserForm	End User Form
workItemList	Work Item List

Process Mappings

The **Process Type** column lists the system name of the form.

The name listed in the **Process Name Mapped To** column is the name by which the process is identified in Identity Manager IDE and in the Debug page of Identity Manager.

Table A-2 Process System and Product Interface Names

System Name	Mapped to...
abortAccessReview	Abort Access Review
accessReview	Access Review
accessReviewScan	Access Scan
accessReviewRescan	Access Review Rescan
auditPolicyRescan	Audit Policy Rescan
changeResourceAccountPassword	Change Resource Account Password
changeUserPassword	Change User Password
createResourceGroup	Create Resource Group
createResourceObject	Create Resource Object
createResourceOrganization	Create Resource Organization
createResourceOrganizationalUnit	Create Resource Organizational Unit
createResourcePerson	Create Resource Person
createResourceUser	Create Resource User
createUser	Create User
delegateWorkItems	Delegate WorkItems
deleteAccessReview	Delete Access Review
deleteAccount	Delete Resource Account
deleteResourceGroup	Delete Resource Group

Table A-2 Process System and Product Interface Names

System Name	Mapped to...
deleteResourceObject	Delete Resource Object
deleteResourceOrganization	Delete Resource Organization
deleteResourceOrganizationalUnit	Delete Resource Organizational Unit
deleteResourcePerson	Delete Resource Person
deleteResourceUser	Delete Resource User
deleteUser	Delete User
disableUser	Disable User
enableUser	Enable User
endUserAnonymousEnrollment	End User Anonymous Enrollment
endUserUpdateGroups	End User Update Groups
endUserUpdateMyGroups	End User Update My Groups
endUserUpdateMyResources	End User Update My Resources
endUserUpdateMyRoles	End User Update My Roles
endUserUpdateResources	End User Update Resources
endUserUpdateRoles	End User Update Roles
handleNativeChangeToAccountAttributes	Audit Native Changes to Account Attributes
lockUser	Lock User
manageResource	Manage Resource
manageRole	Manage Role
passwordLogin	Password Login
questionLogin	Question Login
recoverAccessReview	Recover Access Review
renameUser	Rename User
resetUserPassword	Reset User Password
unlinkResourceAccountsFromUser	Unlink Resource Accounts From User
unlockUser	Unlock User
updateResourceGroup	Update Resource Group
updateResourceObject	Update Resource Object
updateResourceOrganization	Update Resource Organization
updateResourceOrganizationalUnit	Update Resource Organizational Unit

Table A-2 Process System and Product Interface Names

System Name	Mapped to...
updateResourcePerson	Update Resource Person
updateResourceUser	Update Resource User
updateUser	Update User Template

NOTE The Access Review task is implemented as a Workflow. All other tasks are implemented as Java tasks.

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