Red Hat JBoss BRMS 6.3

User Guide

The User Guide for Red Hat JBoss BRMS

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Abstract

A guide to defining and managing business processes with Red Hat JBoss BRMS.

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CHAPTER 1. INTRODUCTION

1.1. ABOUT RED HAT JBOSS BRMS

Red Hat JBoss BRMS is an open source decision management platform that combines Business Rules Management and Complex Event Processing. It automates business decisions and makes that logic available to the entire business.

Red Hat JBoss BRMS uses a centralized repository where all resources are stored. This ensures consistency, transparency, and the ability to audit across the business. Business users can modify business logic without requiring assistance from IT personnel.

Business Resource Planner is included with this release.

Red Hat JBoss BRMS is supported for use with Red Hat Enterprise Linux 7 (RHEL7).

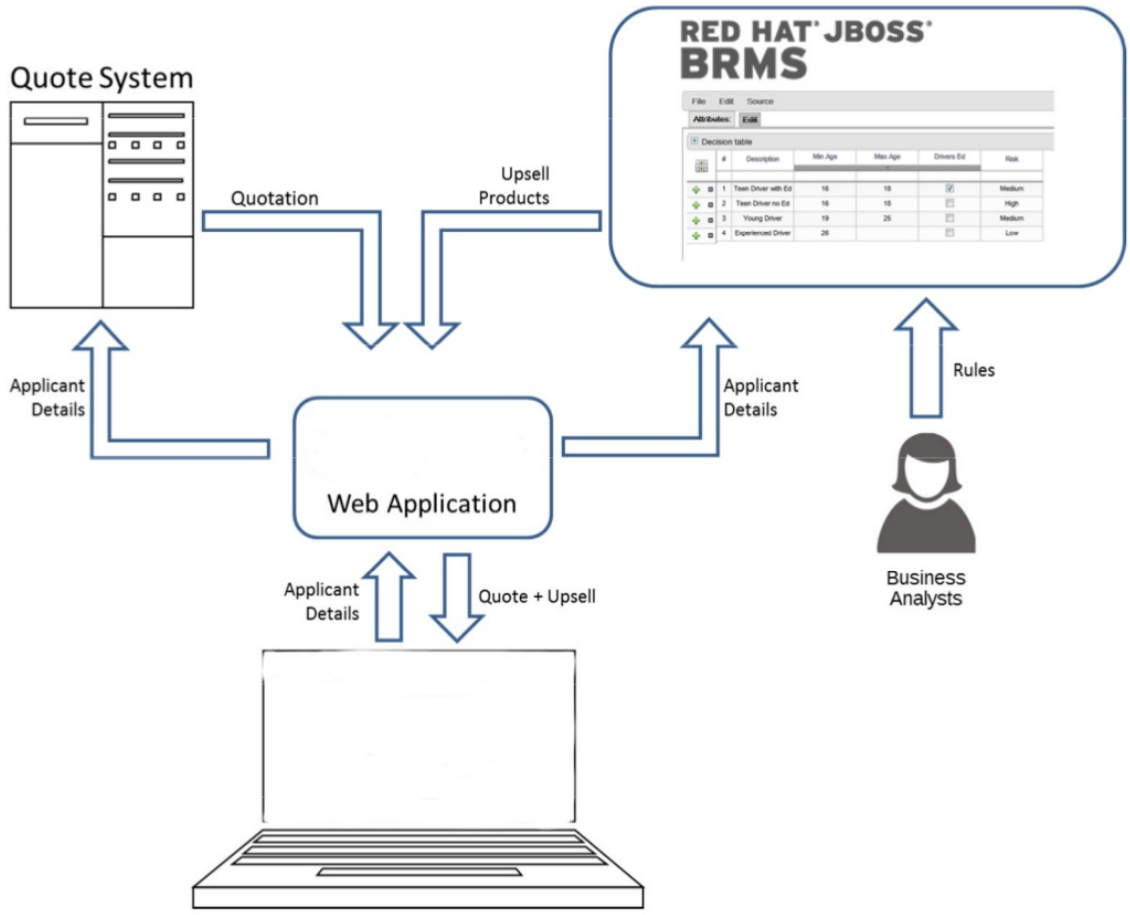
1.2. USE CASE: BUSINESS DECISION MANAGEMENT IN THE INSURANCE INDUSTRY WITH RED HAT JBOSS BRMS

Red Hat JBoss BRMS comprises a high performance rule engine, a rule repository, easy to use rule authoring tools, and complex event processing rule engine extensions. The following use case describes how these features of JBoss BRMS are implemented in insurance industry.

The consumer insurance market is extremely competitive, and it is imperative that customers receive efficient, competitive, and comprehensive services when visiting an online insurance quotation solution. An insurance provider increased revenue from their online quotation solution by upselling relevant, additional products during the quotation process to the visitors of the solution.

The diagram below shows integration of JBoss BRMS with the insurance provider’s infrastructure. This integration is fruitful in such a way that when a request for insurance is processed, JBoss BRMS is consulted and appropriate additional products are presented with the insurance quotation.

Figure 1.1. JBoss BRMS Use Case: Insurance Industry Decision Making



JBoss BRMS provides the decision management functionality, that automatically determines the products to present to the applicant based on the rules defined by the business analysts. The rules are implemented as decision tables, so they can be easily understood and modified without requiring additional support from IT.

1.3. ASSETS

Anything that can be stored as a version in the artifact repository is an asset. This includes rules, packages, business processes, decision tables, fact models, and DSLs.

Rules

Rules provide the logic for the rule engine to execute against. A rule includes a name, attributes, a 'when' statement on the left hand side of the rule, and a 'then' statement on the right hand side of the rule.

Business Rules

Business Rules define a particular aspect of a business that is intended to assert business structure or influence the behaviour of a business. Business Rules often focus on access control issues, pertain to business calculations and policies of an organization.

Business Processes

Business Processes are flow charts that describe the steps necessary to achieve business goals (see the *Red Hat JBoss BRMS Business Process Management Guide* for more details).

Projects

A project is a container for packages of assets (business processes, rules, work definitions, decision tables, fact models, data models, and DSLs) that lives in the Knowledge Repository. It is this container that defines the properties of the KIE Base and KIE Session that are applied to its content. In the GUI, you can edit these entities in the Project Editor.

ONLY PACKAGED ASSETS CAN BE DEPLOYED

If an asset, such as a Process or Rule definition, is not placed in a package with a Project, it cannot be deployed. Therefore, make sure to organize your assets in packages. Also note, that the name of the package must be identical with the KIE Session name.

As a project is a Maven project, it contains the Project Object Model file (**`pom.xml`**) with information on how to build the output artifact. It also contains the Module Descriptor file, **`kmodule.xml`**, that contains the KIE Base and KIE Session configuration for the assets in the project.

Packages

Packages are deployable collections of assets. Rules and other assets must be collected into a package before they can be deployed. When a package is built, the assets contained in the package are validated and compiled into a deployable package.

Domain Specific Languages

A domain specific languages, or DSL, is a rule language that is dedicated to the problem domain.

Decision Tables

Decision Tables are collections of rules stored in either a spreadsheet or in the JBoss BRMS user interface as guided decision tables.

Data Model

Data models are a collection of facts about the business domain. The rules interact with the data model in rules-based applications.

CHAPTER 2. BUSINESS CENTRAL

Business Central is the web based user interface used for both Red Hat JBoss BRMS 6 and Red Hat JBoss BPM Suite 6.

It is the user interface for the business rules manager and has been combined with the core drools engine and other tools. It allows a business user to manage rules in a multi user environment and implement changes in a controlled fashion.

The Business Central is used when:

- Users need to manage versions/deployment of rules.
- Multiple users of different skill levels need to access and edit rules.
- You need an infrastructure to manage rules.

Business Central is managed by the Business Analysts, Rule experts, Developers and Administrators (rule administrators).

The main features of the Business Central are:

- Multiple types of rule editors (GUI, text) including:-
  - Guided Rule Editor
  - Rule Templates
  - Decision Tables
- Store multiple rule "assets" together as a package
- Domain Specific Language support
- Complex Event Processing support
- Version control (historical assets)
- Testing of rules
- Validation and verification of rules
- Categorization
- Build and deploy including:-
  - Assembly of assets into a binary package for use with a ChangeSet or KnowledgeBuilder.
- REST API to manipulate assets.

2.1. LOGGING ON TO BUSINESS CENTRAL

Log into Business Central after the server has successfully started.

1. Navigate to http://localhost:8080/business-central in a web browser. If the user interface has been configured to run from a domain name, substitute **`localhost`** for the domain name. For example http://www.example.com:8080/business-central.

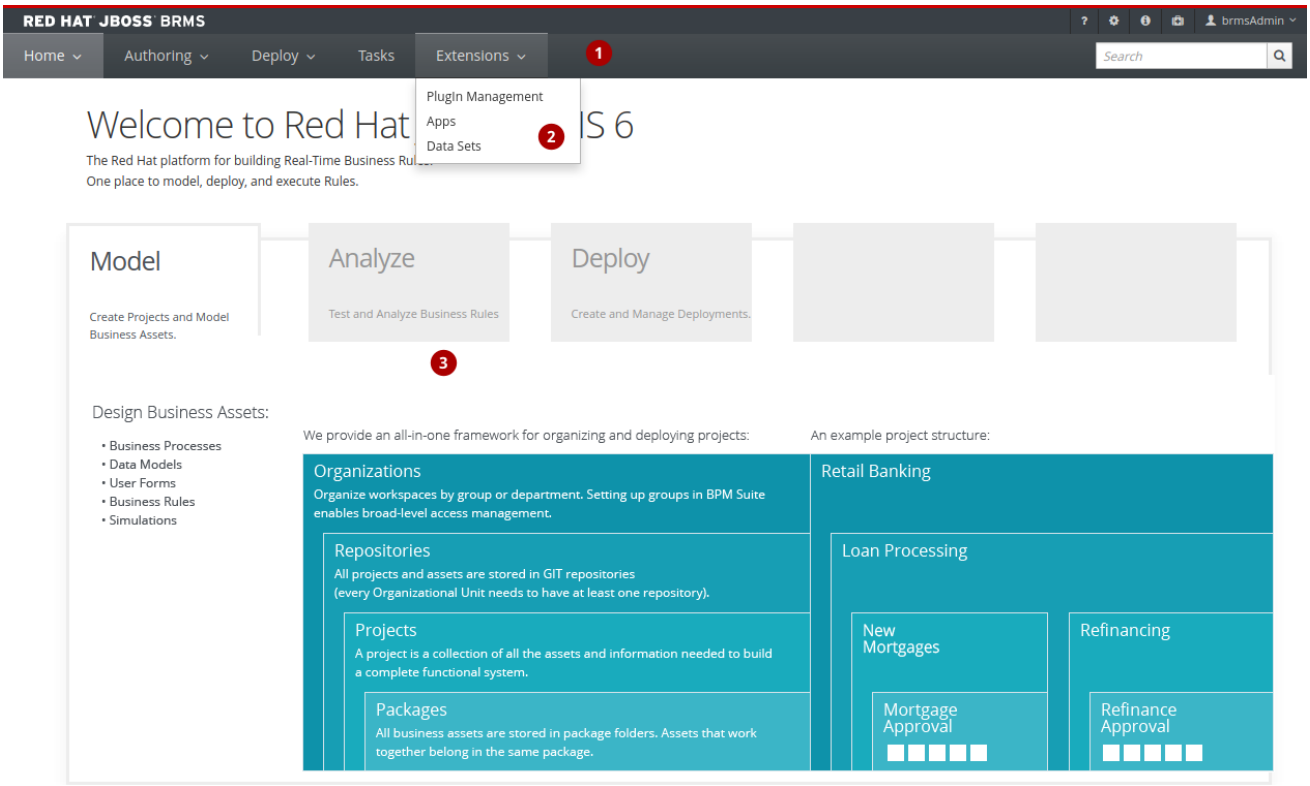
2. Log in with the user credentials that were created during installation. For example: User = **`helloworlduser`** and password = **`Helloworld@123`**.

2.2. THE HOME SCREEN

The **Home** view or the "landing page" is the default view for the application. There are two menu items available in this view: **Authoring** and **Deployment**, besides the **Home** menu option.

The following screen shows what the Home view looks like:

Figure 2.1. Business central home screen



The main menu contains the links to the **`Home`** page and all available perspectives.

The perspective menu contains menus for the selected perspective.

The perspective area contains the perspective tools (here the home page with links to individual perspectives and their views), such as views and editors.

2.2.1. Perspectives

Business Central provides the following groups of perspectives accessible from the main menu:

- **Authoring** group:
  - **Project Authoring** perspective contains:

        - The **Project Explorer** view with the overview of available repository structure, and information on available resources, such as, business process definitions, form definitions, and others.
        - The editor area on the right of the **Project Explorer** view, where the respective editor appears when a resource is opened.
        - The **Messages** view with validation messages.
    - **Contributors** perspective enables you to view the number of commits sorted by the organizational unit, repository, author, and other criteria.
    - **Artifact Repository** perspective contains a list of jars which can be added as dependencies. The available operations in this perspective are upload/download artifact and open (view) the **`pom.xml`** file.
      The view is available for users with the **`admin`** role only.
    - **Administration** perspective contains:
        - The **File Explorer** view with available asset repositories
        - The editor area on the right of the **File Explorer** view, where the respective editor appears when a resource is opened.
          The **Administration** perspective allows an administrator to connect a Knowledge Store to a repository with assets and to create a new repository. For more information, see the *Red Hat JBoss BRMS Administration and Configuration Guide*.

          The view is available for users with the **`admin`** role only.
- **Deploy** group:
    - **Rule Deployments** perspective contains a list of the deployed Realtime Decision Server templates and containers associated with the templates.
- **Tasks** group:
    - **Task List** perspective contains a list of Tasks produced by Human Task of the Process instances or produced manually. Only Tasks assigned to the logged-in user are visible. It allows you to claim Tasks assigned to a group you are a member of.
- **Extensions**
    - **PlugIn Management** perspective enables you to customize and create new Business Central perspectives and plugins.
    - **Apps** perspective enables you to browse, categorize and open custom perspective plugins.
    - **Data Sets** perspective enables you to define and connect to external data sets.

2.3. EMBEDDING BUSINESS CENTRAL

Business Central provides a set of editors to author assets in different formats. A specialized editor is used according to the asset format.

Business Central provides the ability to embed it in your own (Web) Applications using standalone mode. This allows you to edit rules, processes, decision tables, and other assets in your own applications without switching to Business Central.

In order to embed Business Central in your application, you will need the Business Central application deployed and running in a web/application server and, from within your own web applications, an iframe with proper HTTP query parameters as described in the following table.

Table 2.1. HTTP Query Parameters for Standalone Mode

Parameter Name	Explanation	Allow Multiple Values	Example
standalone	This parameter switches Business Central to standalone mode.	no	(none)
path	Path to the asset to be edited. Note that asset should already exists.	no	git://master@uf-playground/todo.md
perspective	Reference to an existing perspective name.	no	org.guvnor.m2repo.client.perspectives.GuvnorM2RepoPerspective
header	Defines the name of the header that should be displayed (useful for context menu headers).	yes	ComplementNavArea

The following example demonstrates how to set up an embedded Author Perspective for Business Central.

```
===test.html===
 <html>
  <head>
    <title>Test</title>
  </head>
  <body>
    <iframe id="ifrm" width="1920" height="1080"
src='http://localhost:8080/business-central?
standalone=&perspective=AuthoringPerspective&header=AppNavBar'></iframe>
  </body>
</html>
```

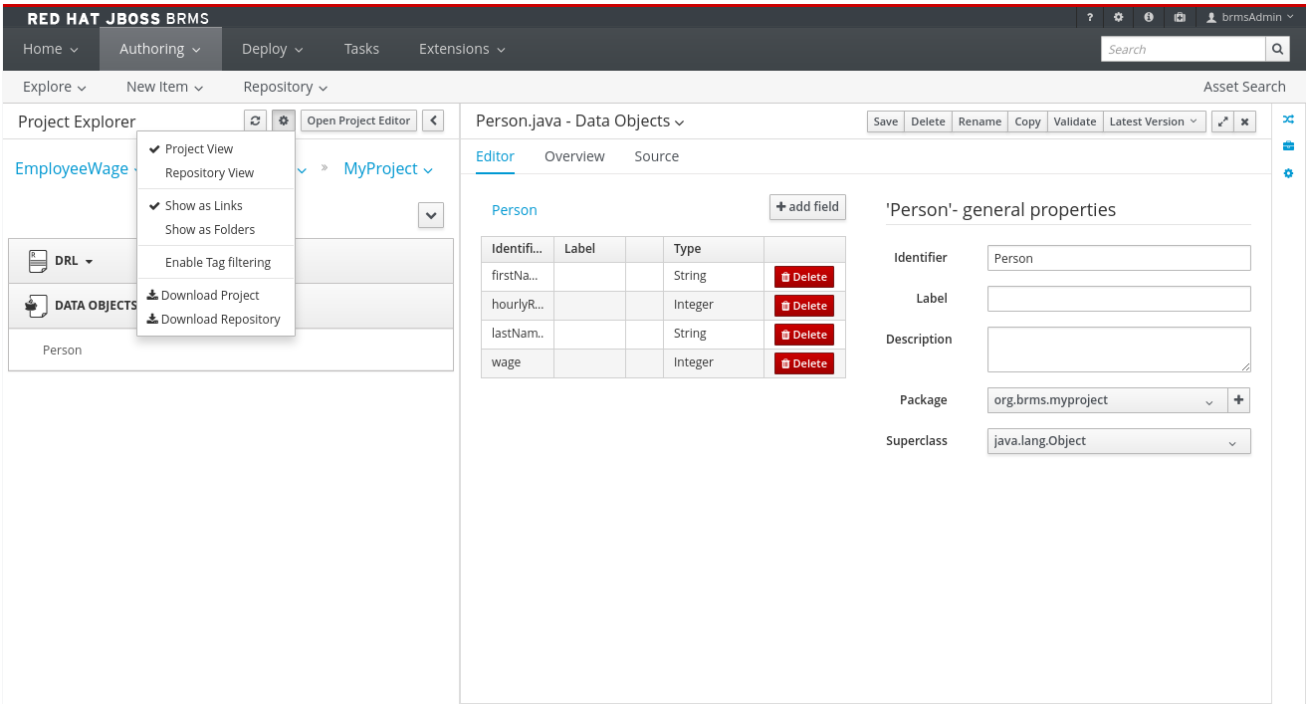
X-frame options can be set in **web.xml** of business-central. The default value for**x-frame-options** is as follows:

```
<param-name>x-frame-options</param-name>
  <param-value>SAMEORIGIN</param-value>
```

2.4. PROJECT AUTHORING

Projects and the associated assets can be authored from the Project Explorer. The Project Explorer can be accessed from the Home screen by clicking on **Authoring → Project Authoring**.

Figure 2.2. The Project Explorer screen



The project authoring screen is divided into 3 sections:

- *Project Explorer*: The left pane of the project authoring screen is the project explorer that allows you to navigate through projects and create the required packages and assets. Clicking on the () button allows you to set the view to Project view or Repository view. The contents of the project can be navigated in a tree view by clicking on the **Show as Folders** or in a single-line path by clicking on the **Show as Links**.

- *Content area*: The content area shows the assets which are opened for editing. It has a toolbar with buttons like **Save**, **Delete**, **Rename**, **Copy**, and **Validate** that can be used to perform the required actions on the assets that are being worked upon.

- *Problems*: The problems area shows the validation errors of the project that occur while saving or validating a particular asset.

2.4.1. Changing the Layout

The layout of any panel can be changed by the user. Each panel can be resized and repositioned, except for the Project Explorer panel, which can only be resized and not repositioned.

Resizing the layout
The layout can be resized in the following ways:

1. To resize the width of the screen:

   a. Move the mouse pointer over the vertical panel splitter. The pointer changes to

 .

b. Adjust the width of the screen by dragging the splitter and setting it at the required position.

2. To resize the height of the screen:

a. Hover the cursor over the horizontal panel splitter. The pointer changes to  .

b. Adjust the height of the screen by dragging the splitter and setting the required position.

Repositioning the layout
To reposition the layout, do the following:

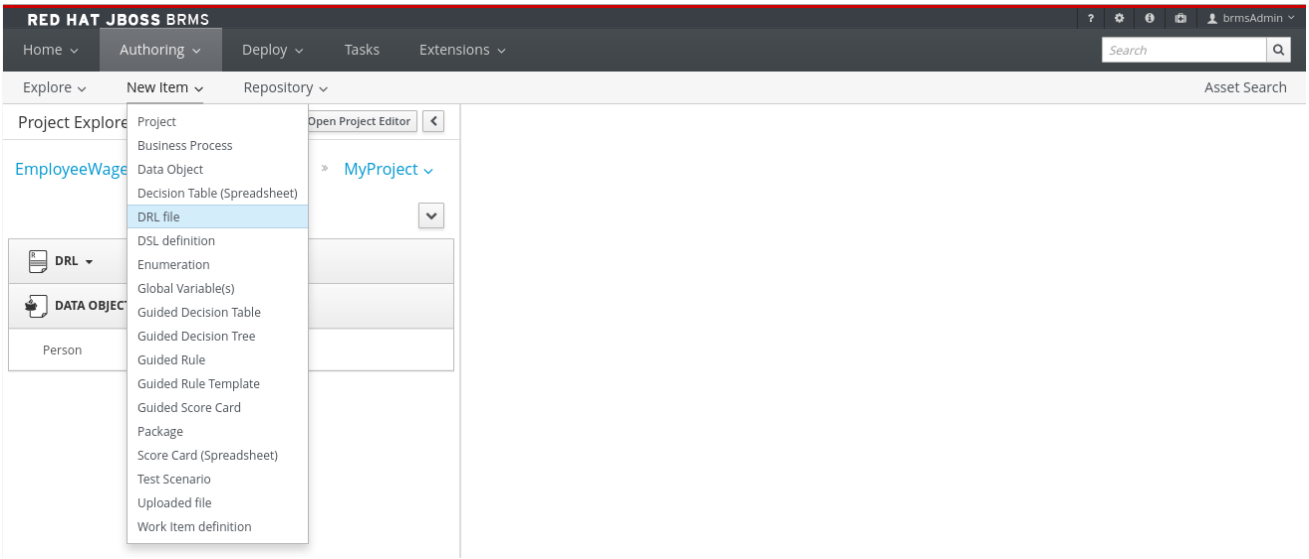
1. Move the mouse pointer on the title of the panel. The pointer changes to  .

2. Press and hold the left click of the mouse and drag the screen to the required location. A  symbol indicating the target position is displayed to set the position of the screen.

2.4.2. Creating new assets

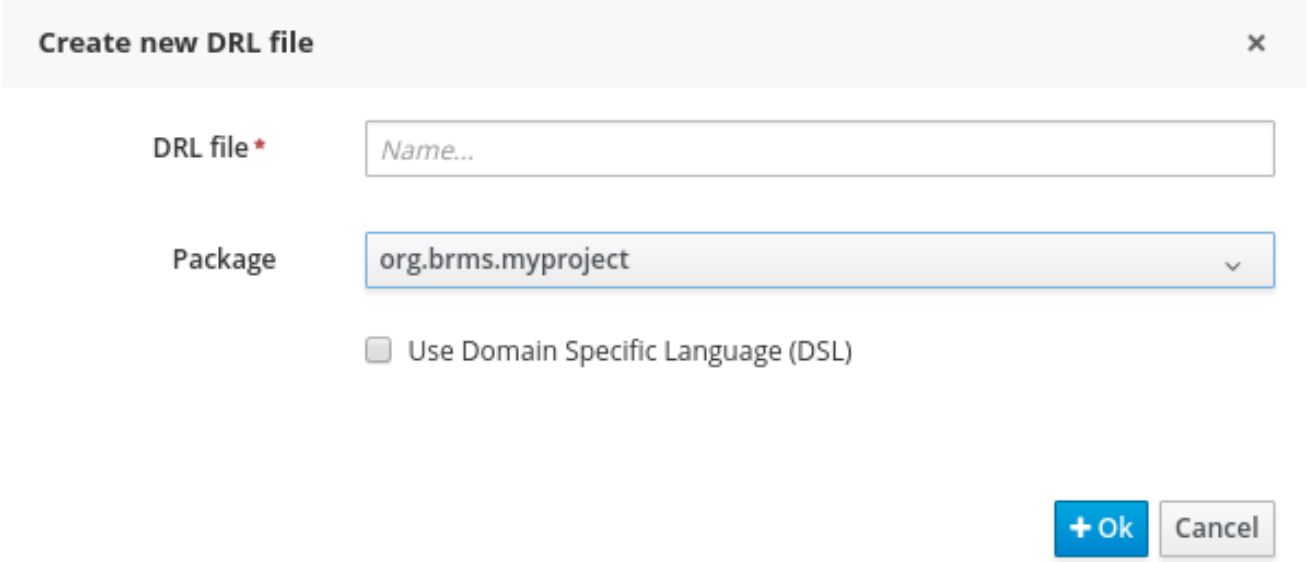
Assets can be created using the **New Item** perspective menu option.

Figure 2.3. Creating new Asset screen



Clicking on an Asset from the **New Item** menu will open a**Create new (Asset-type)** pop-up dialog where a user can enter the name of the Asset.

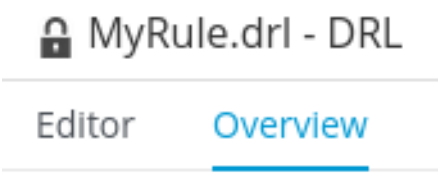
Figure 2.4. Create new pop-up dialog



2.4.3. Asset Metadata and Versioning

Most assets within Business Central have some metadata and versioning information associated with them. In this section, we will go through the metadata screens and version management for one such asset (a DRL asset). Similar steps can be used to view and edit metadata and versions for other assets.

Metadata Management
To open up the metadata screen for a DRL asset, click on the **Overview** tab. If an asset doesn't have an **Overview** tab, it means that there is no metadata associated with that asset.



The **Overview** section opens up in the**Version history** tab, and you can switch to the actual metadata by clicking on the **Metadata** tab.

The metadata section allows you to view or edit the **`Tags`**, **`Subject`**, **`Type`**, **`External Link`** and **`Source metadata`** for that asset. However, the most interesting metadata is the description of the asset that you can view/edit in the description field and the comments that you and other people with access to this asset can enter and view.

Comments can be entered in the text box provided in the comments section. Once you have finished entering a comment, press enter for it to appear in the comments section.

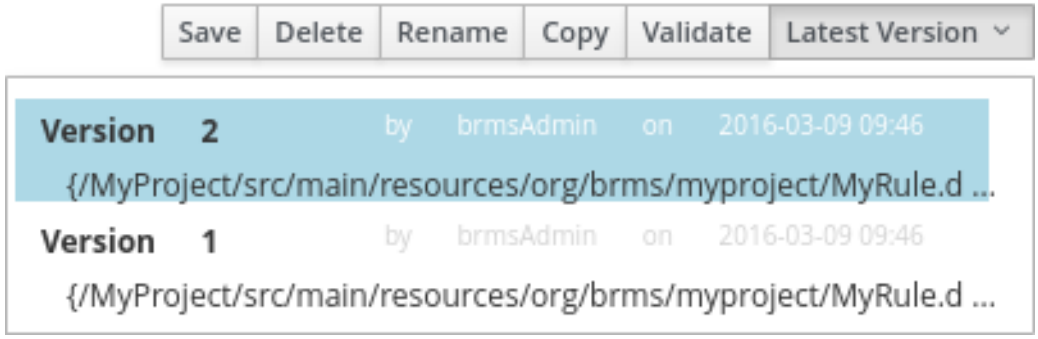
IMPORTANT

You must hit the **Save** button for all metadata changes to be persisted, including the comments.

Version Management
Every time you make a change in an asset and save it, a new version of the asset is

created. You can switch between different versions of an asset in one of two ways:

- Click the **Latest Version** button in the asset toolbar and select the version that you are interested in. Business Central will load this version of the asset.



- Alternatively, open up the **Overview** section. The **Version history** section shows you all the available versions. **Select** the version that you want to restore.

In both cases, the **Save** button will change to **Restore**. Click this button to persist changes.

2.5. ASSET LOCKING SUPPORT

The default locking mechanism for locking a BPM and BRMS asset while updating it in Business Central is pessimistic. Whenever you open and modify an asset in Business Central, it automatically locks the asset for your exclusive use, in order to avoid conflicts in a multi-user setup. The pessimistic lock is automatically released when your session ends or when you save or close the asset.

The pessimistic lock feature is provided in order to help prevent users from overwriting each other's changes. However, there may be cases when you may want to edit a file locked by another user. Business Central allows you to force unlock a locked asset. To do this:

Procedure: Unlocking assets

1. Open the asset.
2. Click on the **Overview** tab and open up the **Metadata** screen.
   If the asset is already being edited by another user, the following will be displayed in the **Lock status** field:

   `Locked by <user_name>`
3. To edit the asset locked by another user, click **Force unclock asset** button.
   The following confirmation popup message is displayed:

   `Are you sure you want to release the lock of this asset? This might cause <user_name> to lose unsaved changes!`
4. Click **Yes** to confirm.
   The asset goes back to unlocked state.

2.6. PROJECT EDITOR

2.6.1. The Project Editor

The Project Editor helps a user to build and deploy projects. This view provides access to the various properties of a Red Hat JBoss BRMS Project that can be edited through the Web interface. Properties like Group artifact version, Dependencies, Metadata, Knowledge Base Settings and Imports can be managed from this view. The editor shows the configuration options for the current active project and the content changes when you move around in your code repository.

To access the Project Editor:

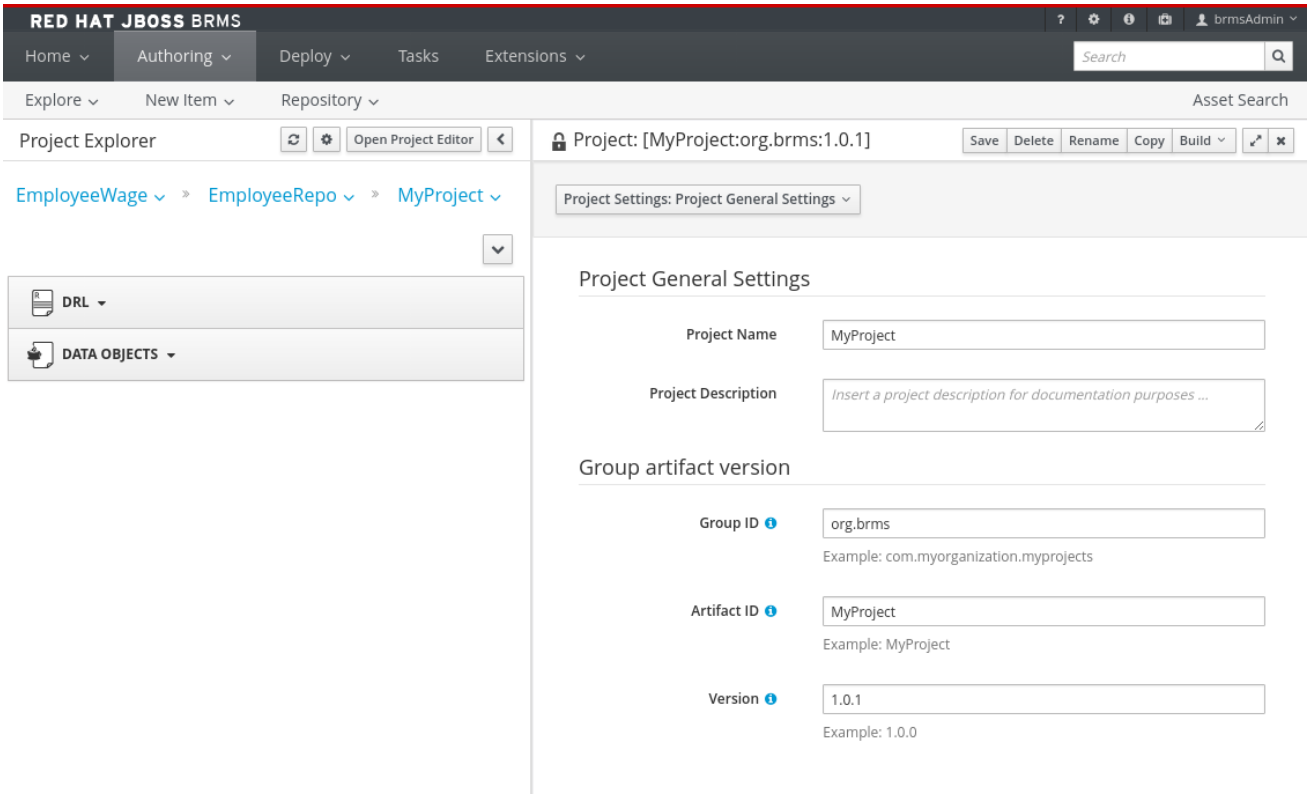
1. Click **Authoring → Project Authoring**.
2. Select your project.
3. Click **Open Project Editor**.

2.6.2. Project Settings

Project General Settings

The Project settings screen allows a user to set the Group, Artifact, and Version ID's for a project. It edits the **`pom.xml`** setting file since we use Maven to build our projects.

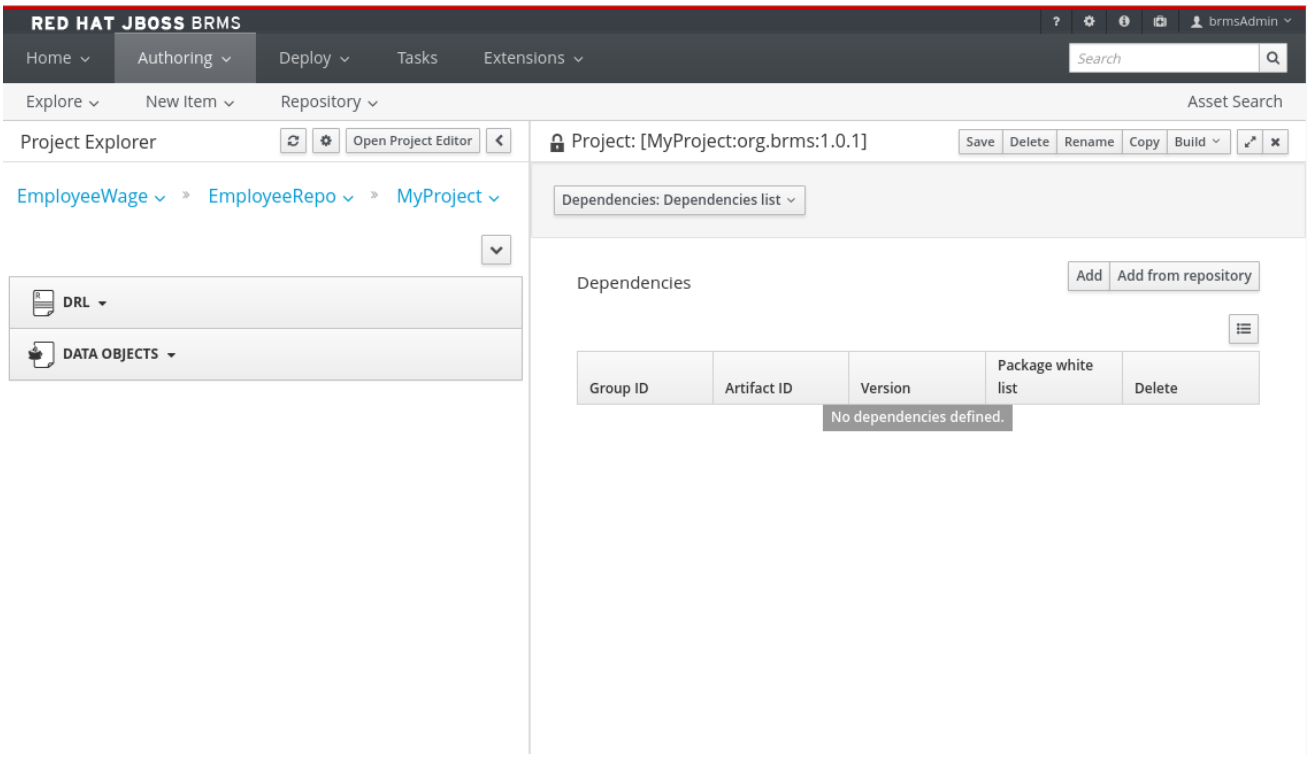
Figure 2.5. Project Editor - Project Settings



Dependencies

The Dependencies option allows you to set the dependencies for the current project.You access the dependencies by using **Project Settings → Dependencies** option. You can add dependencies from the Artifact repository by clicking the **Add from repository** button or by entering the Group ID, Artifact ID and Version ID of a project directly by clicking on the **Add** button.

Figure 2.6. Project Editor - Project Dependencies

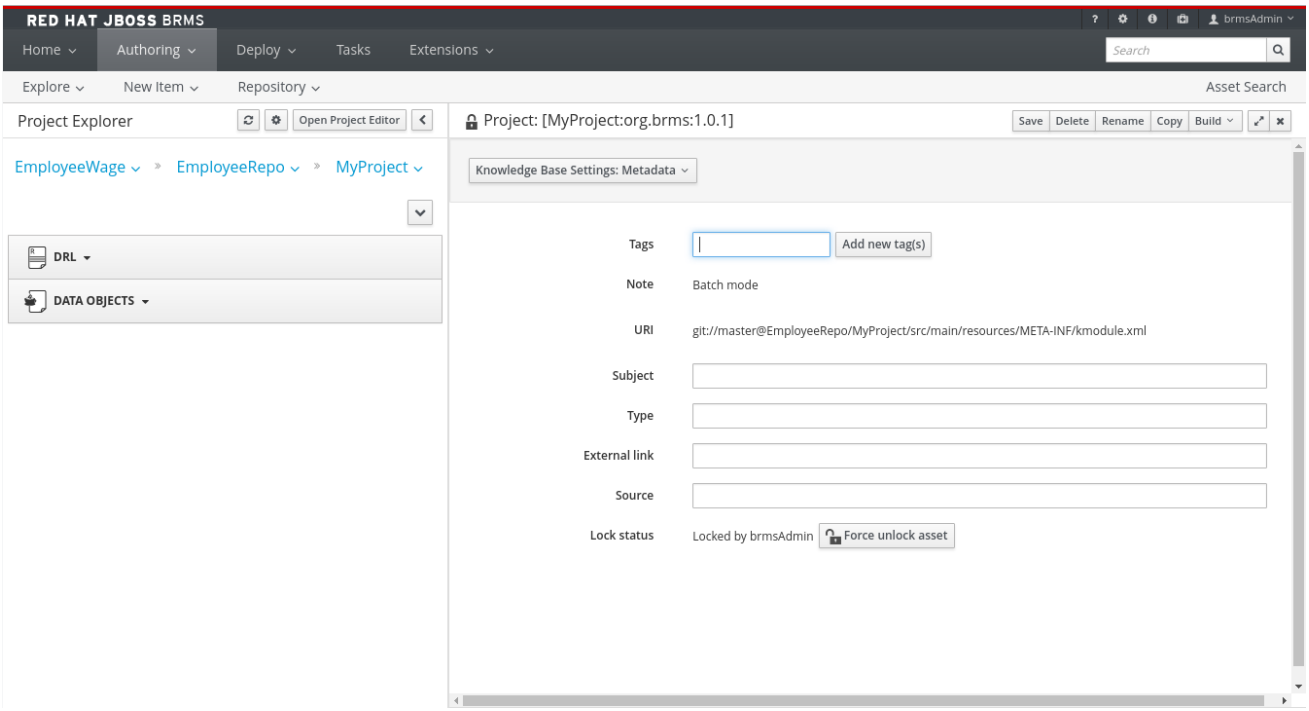


Metadata

The Metadata screen displays various data and version history of a project. It enables you to edit metadata details, add descriptions, and participate in discussions which are specific to a selected asset. You can add metadata to a project, a knowledge base (kmodule) and project imports. Each metadata tab provides the following fields:

- **Tags**: A tagging system for grouping the assets.
- **Note**: A comment from the last asset update.
- **URI**: A unique identifier of the asset inside of the Git repository.
- **Subject**, **Type**, **External link**, **Source**: Miscellaneous asset meta data.
- **Lock status** - Lock status of an asset.

Figure 2.7. Knowledge Base Settings - Metadata



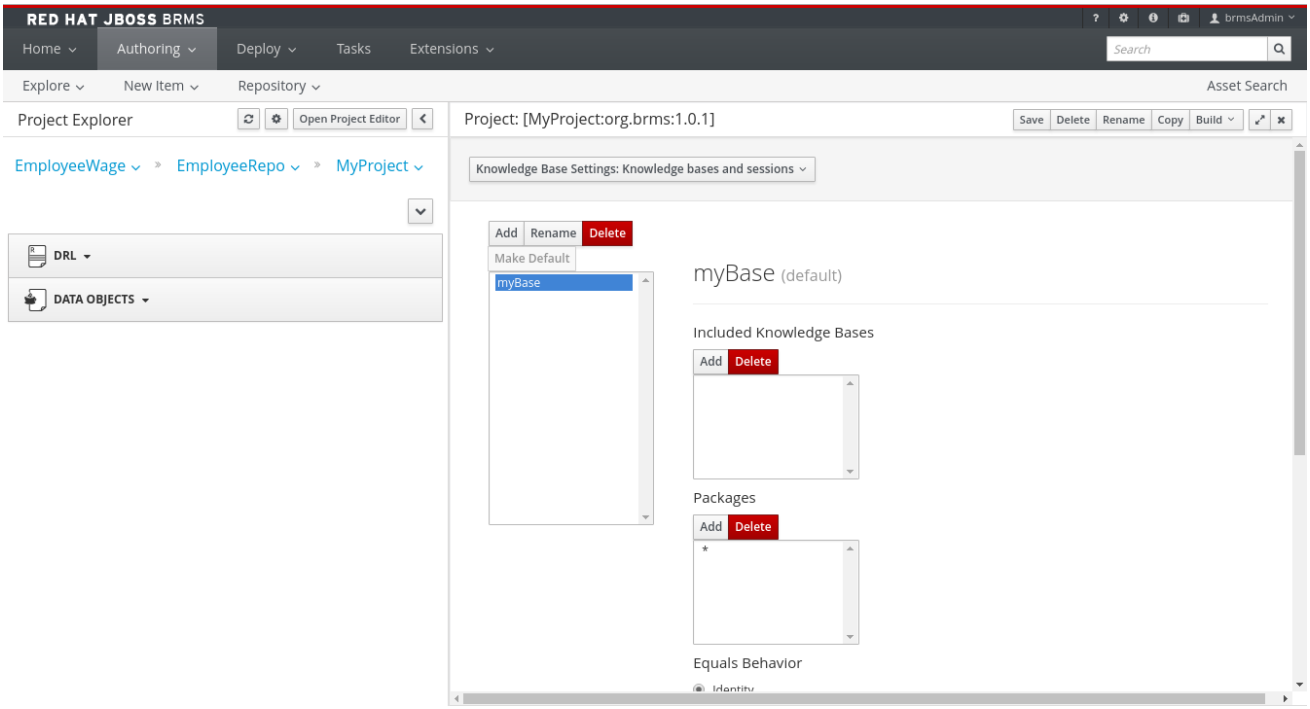
2.6.3. Knowledge Base Settings

Knowledge Bases and Sessions

The Knowledge Base Settings allows the user to create the KIE bases and sessions using the **`kmodule.xml`** project descriptor file of your project. Accordingly, it edits the **`kmodule.xml`** project setting file.

The Knowledge bases and sessions page lists all the knowledge bases by name. It contains the Add, Rename, Delete, and Make Default options above the list. Only one knowledge base can be set as default at a time.

Figure 2.8. Project Editor - Knowledge Base Settings

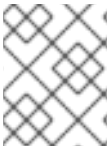


The **Included Knowledge Bases** section displays the models, rules, and any other content in the included knowledge base. It will only be visible and usable by selecting the knowledge base from the Knowledge Base list to the left. You can Add and Delete content from this list.

The **Packages** section allows users to Add and Delete packages which are specified to the knowledge base.

The **Equals Behavior** section allows the user to choose between **`Identity`** or **`Equality`** assertion modes.

- **`Identity`** uses an **`IdentityHashMap`** to store all asserted objects.
- **`Equality`** uses a **`HashMap`** to store all asserted objects.



NOTE

See the kbase attributes section of the Red Hat JBoss BRMS Development Guide for further details about **`Identity`** and **`Equality`** assertion modes.

The **Event Processing Mode** section allows the user to choose between **`Cloud`** and **`Stream`** processing modes.

- **`Cloud`** processing mode is the default processing mode. It behaves in the same manner as any pure forward-chaining rules engine.
- **`Stream`** processing mode is ideal when the application needs to process streams of events.

NOTE

See the kbase attributes section of the Red Hat JBoss BRMS Development Guide for further details about **`Cloud`** and **`Stream`** processing modes.

The **Knowledge Sessions** table lists all the knowledge sessions in the selected knowledge base. By clicking the 

button, you are able to add a new knowledge session to the table.

- The **`Name`** field displays the name of the session.
- The **`Default`** option can only be allocated to one of each type of session.
- The **`State`** drop-down allows either Stateless or Stateful types.
- The **`Clock`** drop-down allows either Realtime or Pseudo choices.
- Clicking the  opens a pop-up that displays more properties for the knowledge session.

Metadata

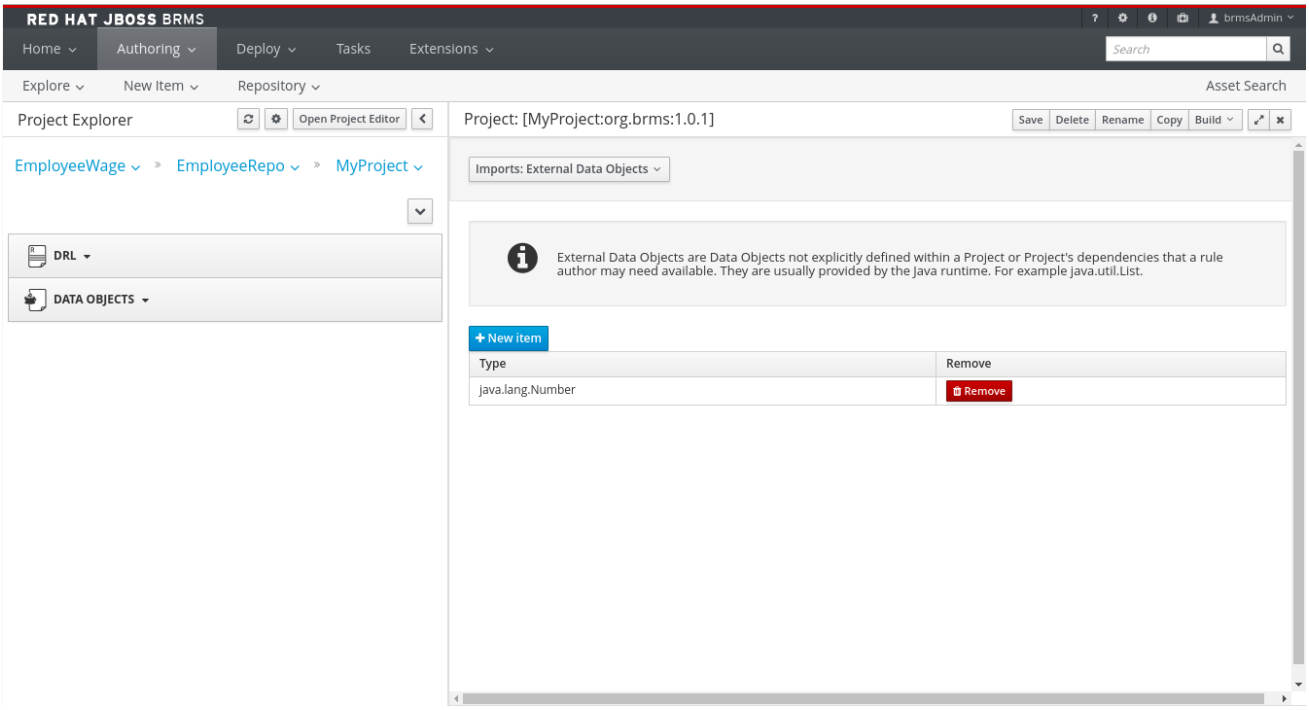
See Section 2.6.2, “Project Settings” for more information about metadata.

2.6.4. Imports

External Data Objects

The External Data Objects specify a set of imports, or external data objects, used in the project. Each asset in a project has its own imports. The imports are used as suggestions when using the guided editors the workbench offers; accordingly, this makes it easier to work with the workbench as there is no need to type each import in every file that uses it. By changing the Import settings, the **`project.imports`** setting files are edited. Data Objects are usually provided by the Java runtime. For example **`java.util.List`**.

Figure 2.9. Project Editor - Imports



To add a fact model to the imports section, click **New Item**. This displays a pop-up dialog to **Add Import** information.Once the Import Type has been entered, click**OK**.

To remove a fact model from the imports section, click **Remove**.

NOTE

The imports listed in the import suggestions are not automatically added into the knowledge base or into the packages of the workbench. Each import needs to be added into each file.

Metadata

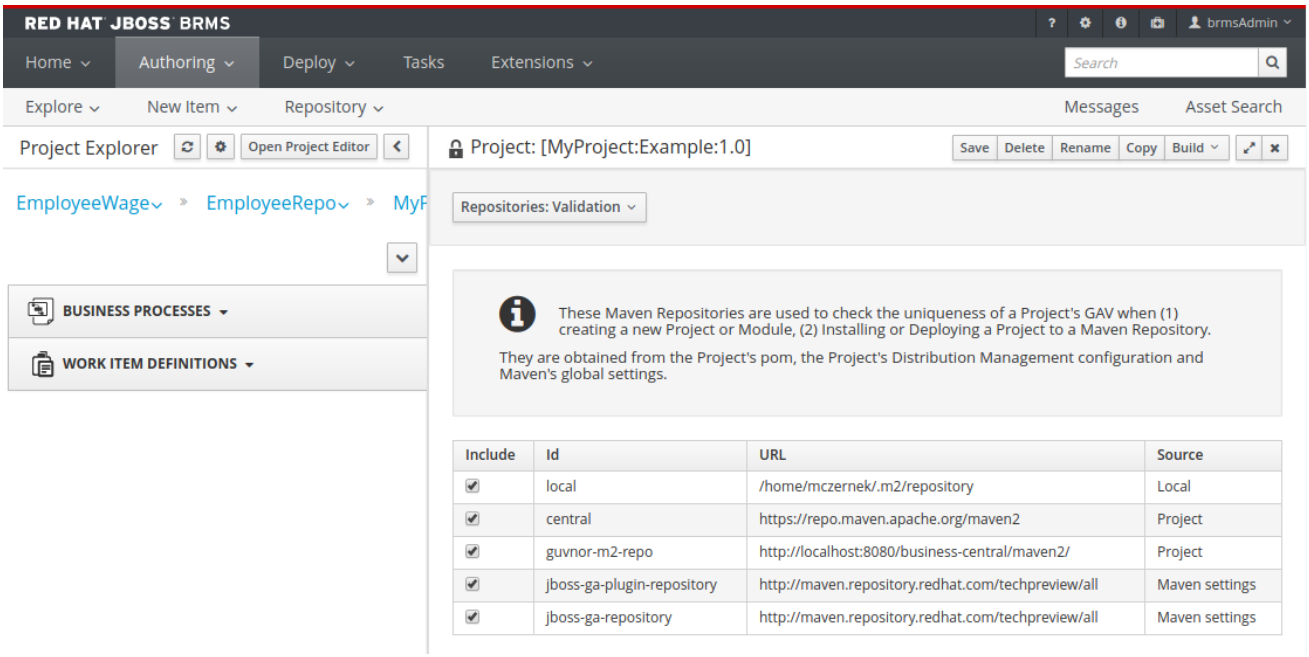
See Section 2.6.2, “Project Settings” for more information about Metadata.

2.6.5. Repositories

Validation

The **Validation** section enables you to select which maven repositories are used to check the uniqueness of your project’s GAV (group ID, artifact ID, and version).

Figure 2.10. Project Editor - Validation



2.6.6. Persistence

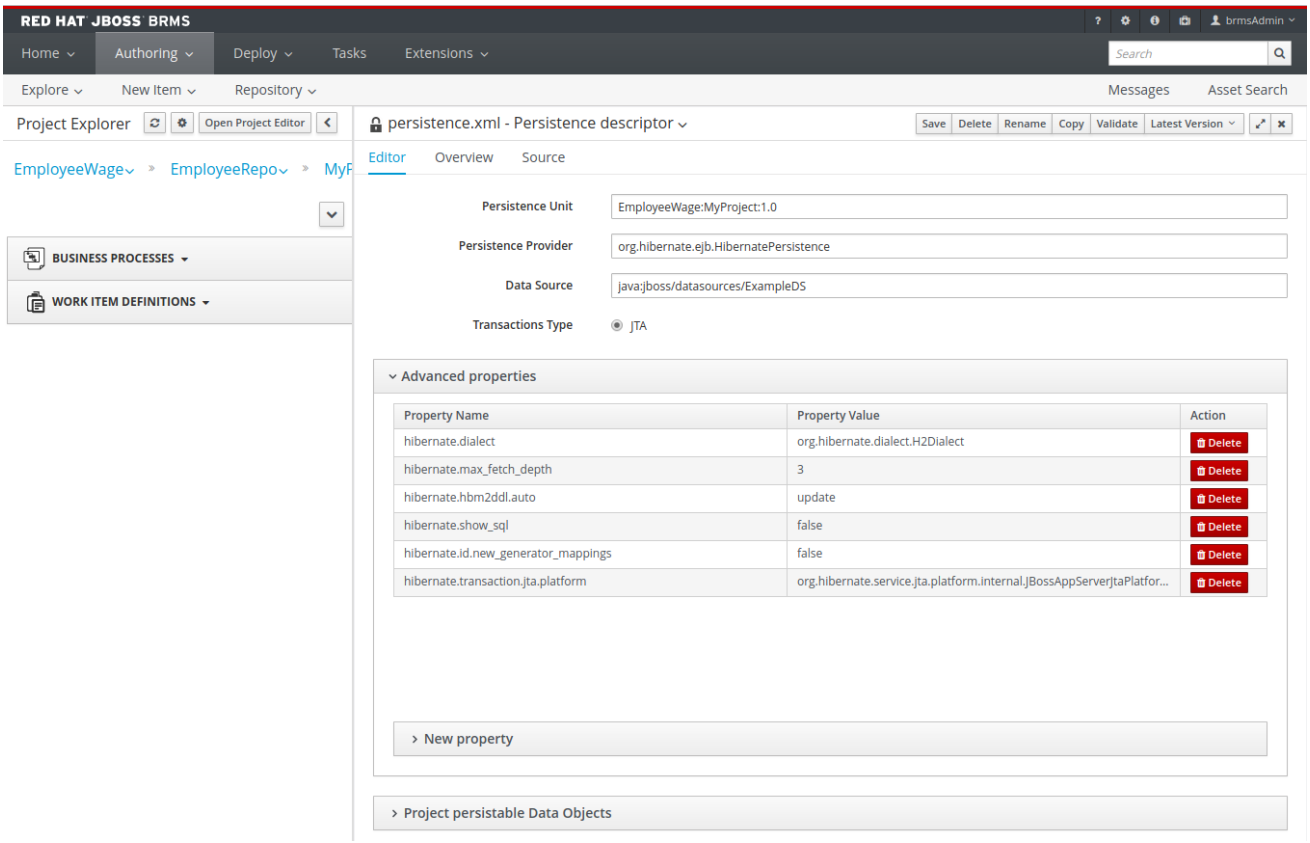
Persistence descriptor

The **Persistence descriptor** section enables you to modify **persistence.xml** through GUI. You can:

- Define a persistence unit provider.
- Define a data source.
- Change predefined properties for your persistence unit.
- Add new properties to your persistence unit.
- Manage persistable data objects.
  The persistable data objects are based on the JPA specification and all the underlying metadata are automatically generated.

Alternatively, click **Source** tab to edit the **persistence.xml** directly.

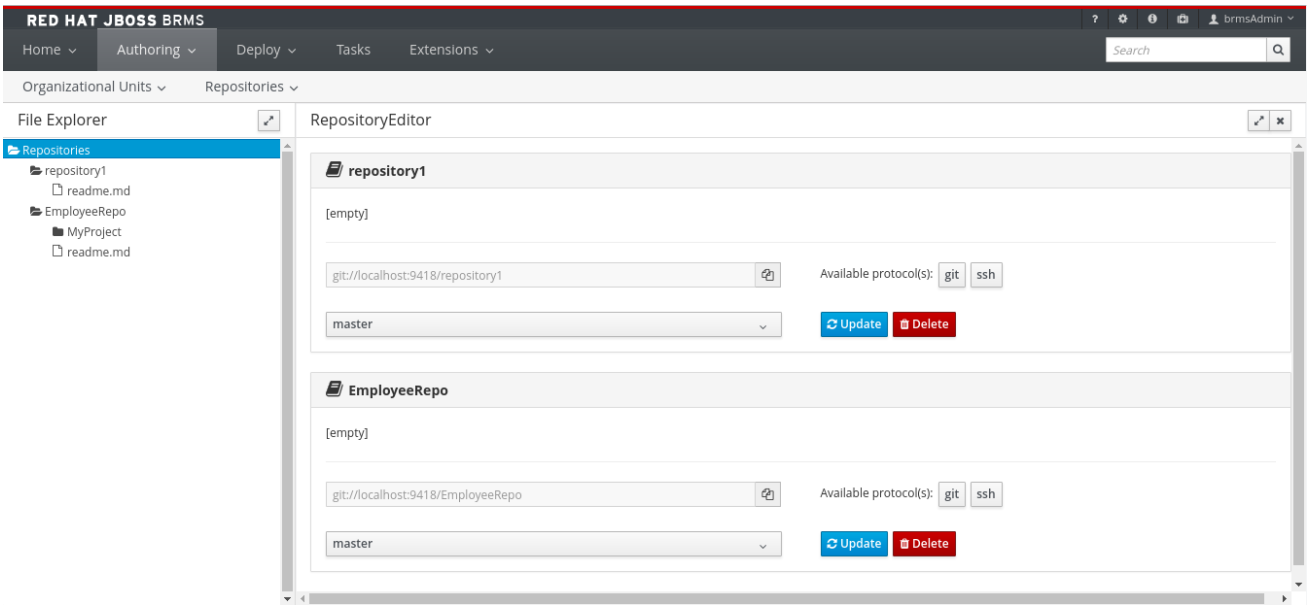
Figure 2.11. Persistence descriptor



2.7. ADMINISTRATION MENU

You can manage Organizational Units and Repositories from the Administration view. Click **Authoring → Administration** to get to this view. For more details on creating and managing these assets, see Chapter 3, *Setting up a New Project*.

Figure 2.12. The Administration Screen



2.8. RENAME, COPY, DELETE ASSETS

2.8.1. Renaming a file or folder

Users can rename a file or a folder directly in Project Explorer.

1. To rename a file or a folder, open **Project Explorer** by selecting **Authoring** → **Project Authoring**.

2. Click the Gear  icon in the upper right hand corner of the **Project Explorer** view and in the menu that opens, select **Repository View**. Click the gear icon again to select the option **Show as Links** (if not already selected).

3. Click the Rename  icon to the right of the file or folder you want to rename. In the displayed **Rename this item** dialog box, enter the new name and click the **Rename item** button.

2.8.2. Deleting a file or folder

Users can delete a file or a folder directly in Project Explorer.

1. To delete a file or a folder, open **Project Explorer** by selecting **Authoring** → **Project Authoring**.

2. Click the Gear icon () in the upper right hand corner of the **Project Explorer** view and in the menu that opens, select **Repository View**. Click the gear icon again to select the option **Show as Links** (if not already selected).

3. Click the Delete icon () to the right of the file or folder you want to rename. In the displayed **Delete this item** dialog box, click the **Delete item** button.

2.8.3. Copying a file or folder

Users can copy a file or a folder directly in Project Explorer.

1. To copy a file or a folder, open **Project Explorer** by selecting **Authoring** → **Project Authoring**.

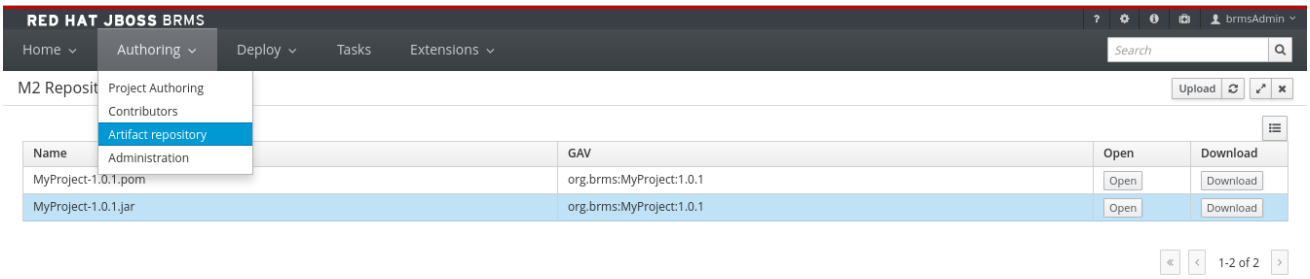
2. Click the Gear  icon in the upper right hand corner of the **Project Explorer** view and in the menu that opens, select **Repository View**. Click the gear icon again to select the option **Show as Links** (if not already selected).

3. Click the Copy  icon to the right of the file or folder you want to copy. In the displayed **Copy this item** dialog box, enter the new name and click the **Create copy** button.

2.9. DEPLOYMENT MENU: THE ARTIFACT REPOSITORY

The **Artifact Repository** explores the Guvnor M2 repository. It shows the list of available kjar files used by the existing projects and allows a user to upload, download and manage the kjar files. It can be accessed by clicking on the **Authoring** → **Artifact Repository** menu on the toolbar.

Figure 2.13. The Artifact Repository Screen



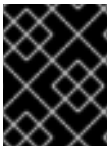
CHAPTER 3. SETTING UP A NEW PROJECT

To create a project a business user has to create an organizational unit. An organizational unit is based on any domain in a particular business sector. It holds the repositories, where projects and packages can be created. Packages are deployable collections of assets like rules, fact models, decision tables and so on, that can be validated and compiled for deployment.

3.1. CREATING AN ORGANIZATIONAL UNIT

It is possible to create an organizational unit in the **Administration** perspective of Business Central, using the **`kie-config-cli`** tool, or the REST API calls.

Creating an Organizational Unit in Business Central



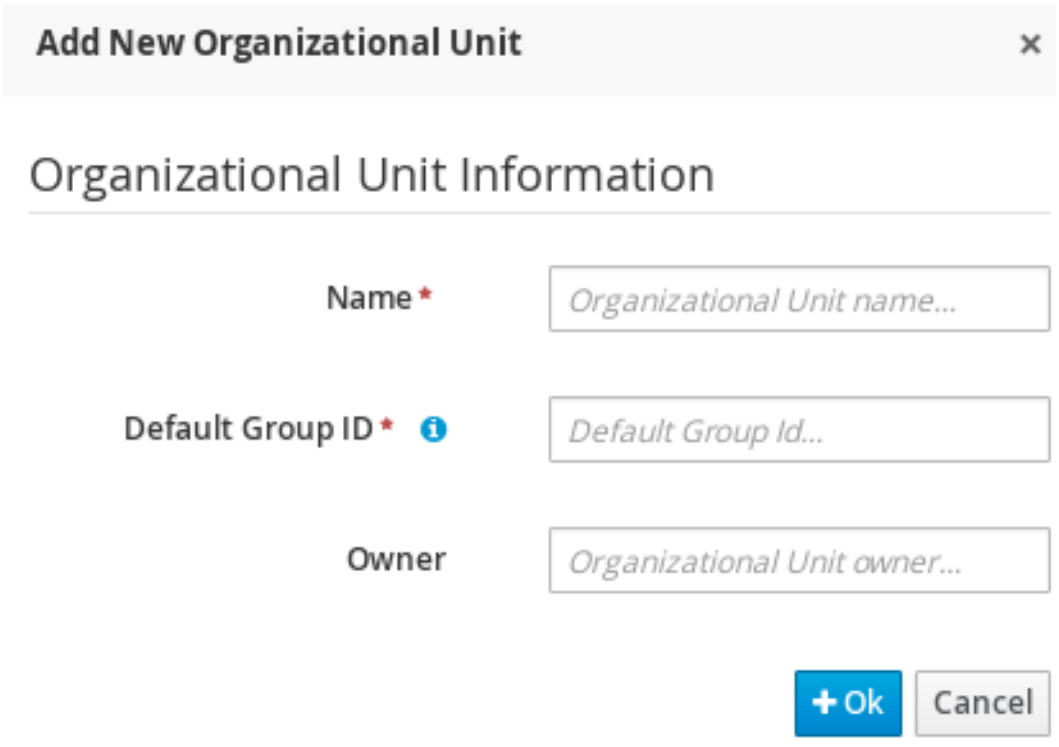
IMPORTANT

Note that only users with the **`admin`** role in Business Central can create organizational units.

Procedure: Using Business Central to Create an Organizational Unit

1. In Business Central, go to **Authoring** → **Administration**.
2. On the perspective menu, click **Organizational Units** → **Manage Organizational Units**.
3. In the **Organization Unit Manager** view, click **Add**.
   The **Add New Organizational Unit** dialog window opens.

   Figure 3.1. *Add New Organizational Unit*Dialog Window



4. Enter the two mandatory parameters (**`name`** and **`default group ID`**) and click **Ok**.

Creating an Organizational Unit Using the kie-config-cli Tool

Organizational units can be created using the **kie-config-cli** tool as well. To do so, run the **create-org-unit** command. The tool then guides you through the entire process of creating an organizational unit by asking for other required parameters. Type **help** for a list of all commands.

For more information about the **kie-config-cli** tool, see *Red Hat JBoss BRMS Administration and Configuration Guide*, chapter Command Line Configuration.

Creating an Organizational Unit Using the REST API

IMPORTANT

Note that only users with the **rest-all** role can create organizational units.

To create an organizational unit in Knowledge Store, issue the **POST** REST API call. Details of the organizational unit are defined by the JSON entity.

Input parameter of the call is an **OrganizationalUnit** instance. The call returns a **CreateOrganizationalUnitRequest** instance.

Example 3.1. Creating an Organizational Unit Using the Curl Utility

Example JSON entity containing details of an organizational unit to be created:

```
{
 "name"         : "helloWorldUnit",
 "owner"        : "tester",
 "description"  :  null,
 "repositories" :  []
}
```

Execute the following command:

```
curl -X POST 'localhost:8080/business-central/rest/organizationalunits/'
-u USERNAME:PASSWORD -H 'Accept: application/json' -H 'Content-Type:
application/json' -d
'{"name":"helloWorldUnit","owner":"tester","description":null,"repositor
ies":[]}'
```

For further information, see the *Red Hat JBoss BPM Suite Development Guide*, chapter *Knowledge Store REST API*, section *Organizational Unit Calls*.

3.2. CREATING A REPOSITORY

There are three ways to create a repository: using the **Administration** perspective of Business Central, the **kie-config-cli** tool, or the REST API calls.

Creating a Repository in Business Central

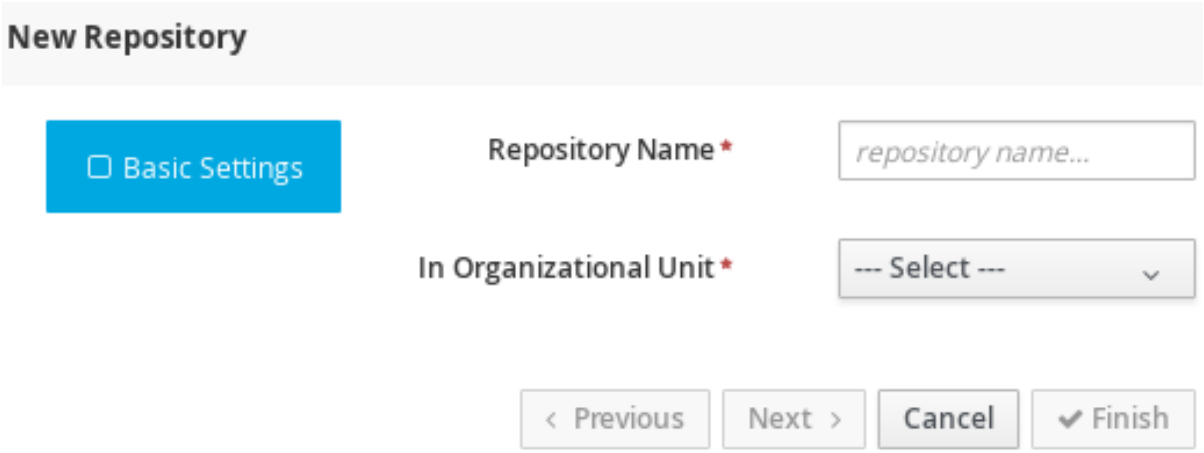
IMPORTANT

Note that only users with the **admin** role in Business Central can create repositories.

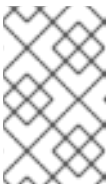
Procedure: Using Business Central to Create a Repository

1. In Business Central, go to **Authoring → Administration**.
2. On the perspective menu, click **Repositories → New repository**.
   The **New Repository** pop-up window is displayed.

   Figure 3.2. *New Repository*Dialog Window



3. Specify the two mandatory parameters:
   - repository name



NOTE

Make sure that the repository name is a valid file name. Avoid using a space or any special character that might lead to an invalid name.

   - organizational unit: specifies the location of the newly created repository.
4. Click **Finish**.

You can view the newly created repository either in the **File Explorer** or the **Project Explorer**.

Creating a Repository Using the kie-config-cli Tool
To create a new Git repository using the **kie-config-cli** tool, run the **create-repo** command. The tool then guides you through the entire process of creating a repository by asking for other required parameters. Type **help** for a list of all commands.

For more information about the **kie-config-cli** tool, see *Red Hat JBoss BRMS Administration and Configuration Guide* .

Creating a Repository Using the REST API

IMPORTANT

Note that only users with the **rest-all** role can create repositories.

To create a repository in the Knowledge Store, issue the **POST** REST API call. Details of the repository are defined by the JSON entity. Make sure you established an authenticated HTTP session before executing this call.

Input parameter of the call is a **RepositoryRequest** instance. The call returns a **CreateOrCloneRepositoryRequest** instance.

Example 3.2. Creating a Repository Using the Curl Utility

Example JSON entity containing details of a repository to be created:

```
{
 "name"                   : "newRepository",
 "description"            :  null,
 "gitURL"                 :  null,
 "requestType"            : "new",
 "organizationalUnitName" : "helloWorldUnit"
}
```

Execute the following command:

```
curl -X POST 'localhost:8080/business-central/rest/repositories/' -u
USERNAME:PASSWORD -H 'Accept: application/json' -H 'Content-Type:
application/json' -d
'{"name":"newRepository","description":null,"requestType":"new","gitURL"
:null,"organizationalUnitName":"helloWorldUnit"}'
```

For further information, see the *Red Hat JBoss BPM Suite Development Guide*, chapter *Knowledge Store REST API*, section *Repository Calls*.

3.3. CLONING A REPOSITORY

It is possible to clone a repository either in Business Central or using the REST API calls. The **kie-config-cli** tool cannot be used to clone arbitrary repositories - run **git clone** or use one of the following options instead.

Cloning a Repository in Business Central

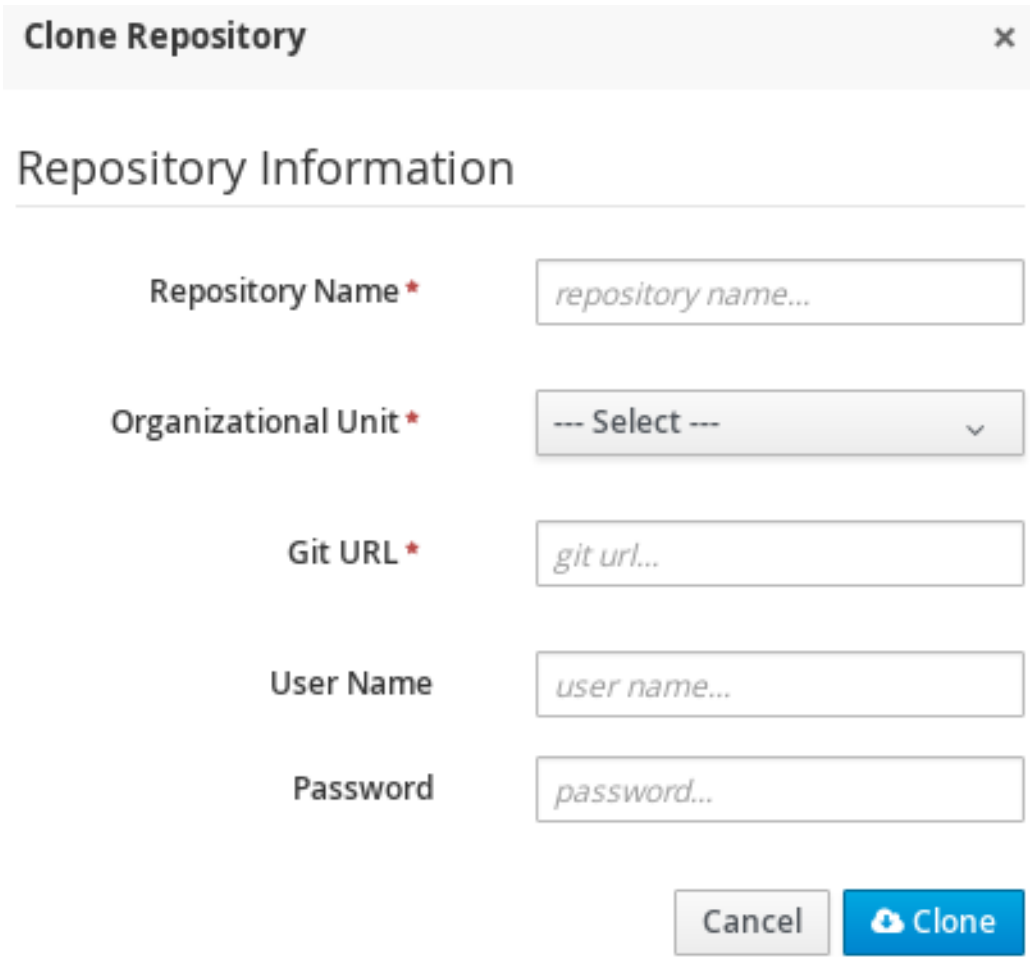
IMPORTANT

Note that only users with the **admin** role in Business Central can clone repositories.

Procedure: Using Business Central to Clone a Repository

1. In Business Central, go to **Authoring** → **Administration**.
2. On the perspective menu, choose **Repositories** → **Clone repository**.
   The **Clone Repository** pop-up window is displayed.

Figure 3.3. *Clone Repository*Dialog Window

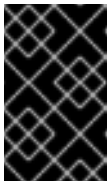


3. In the **Clone Repository** dialog window, enter the repository details:
   a. Enter the **Repository Name** to be used as the repository identifier in the Asset repository and select the **Organizational Unit** it should be added to.
   b. Enter the URL of the Git repository:
      - for a local repository, use **`file:///PATH_TO_REPOSITORY/REPOSITORY_NAME`**;

NOTE

The file protocol is only supported for READ operations. WRITE operations are *not* supported.

      - for a remote or preexisting repository, use **`https://github.com/USERNAME/REPOSITORY_NAME.git`** or **`git://HOST_NAME/REPOSITORY_NAME`**.



IMPORTANT

It is important to use the HTTPS or Git protocol instead of a SCP-style SSH URL. Business Central does not support the basic SSH URL and fails with *Invalid URL format*.

   c. If applicable, enter the **User Name** and **Password** of your Git account to be used for authentication.

4. Click **Clone**.
   A confirmation prompt with the notification that the repository was created successfully is displayed.

5. Click **Ok**.
   The repository is now being indexed. Some workbench features may be unavailable until the indexing has completed.

You can view the cloned repository either in the **File Explorer** or the **Project Explorer**.

Cloning a Repository Using the REST API

IMPORTANT

Note that only users with the **rest-all** role can clone repositories.

To clone a repository, issue the **POST** REST API call. This call creates or clones (according to the value of the **requestType** parameter) the repository defined by the JSON entity.

Input parameter of the call is a **RepositoryRequest** instance. The call returns a **CreateOrCloneRepositoryRequest** instance.

Example 3.3. Cloning a Repository Using the Curl Utility

Example JSON entity containing details of a repository to be cloned:

```
{
 "name"                   : "clonedRepository",
 "description"            :  null,
 "requestType"            : "clone",
 "gitURL"                 : "git://localhost:9418/newRepository",
 "organizationalUnitName" : "helloWorldUnit"
}
```

Execute the following command:

```
curl -X POST 'localhost:8080/business-central/rest/repositories/' -u
USERNAME:PASSWORD -H 'Accept: application/json' -H 'Content-Type:
application/json' -d
'{"name":"clonedRepository","description":null,"requestType":"clone","gi
tURL":"git://localhost:9418/newRepository","organizationalUnitName":"hel
loWorldUnit"}'
```

For further information, see the *Red Hat JBoss BPM Suite Development Guide*, chapter *Knowledge Store REST API*, section *Repository Calls*.

3.4. CREATING A PROJECT

It is possible to create a project either in the **Project Authoring** perspective of Business Central or using the REST API calls.

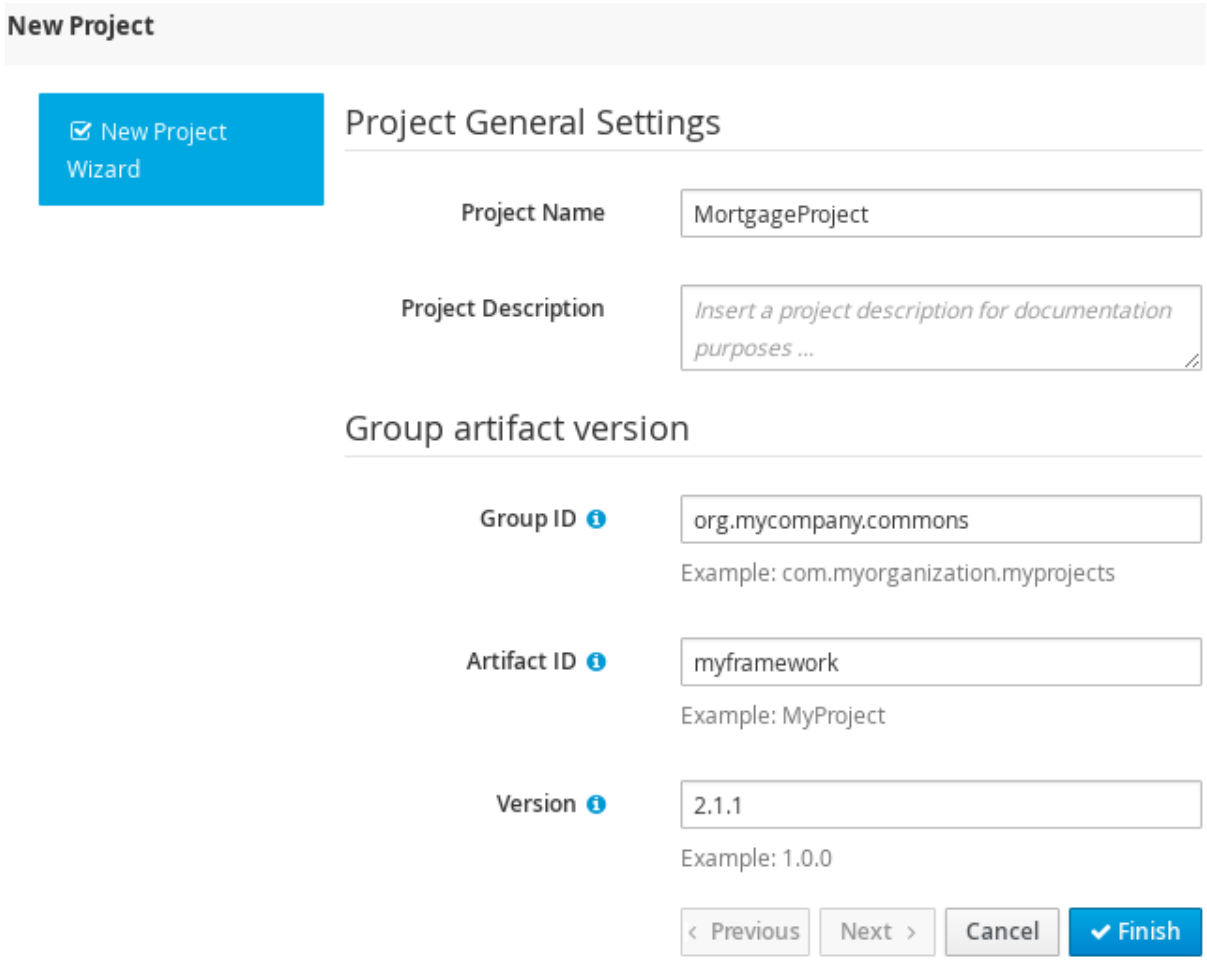
Creating a Project in Business Central

IMPORTANT

Note that only users with the **admin** role in Business Central can create projects.

Procedure: Using Business Central to Create a Project

1. In Business Central, go to **Authoring → Project Authoring**.
2. In the **Project Explorer**, select the organizational unit and the repository in which you want to create the project.
3. On the perspective menu, click **New Item → Project**.
   The **New Project** dialog window opens.



4. Define the **Project General Settings** and **Group artifact version** details of the new project. These parameters are stored in the **pom.xml** Maven configuration file. See the detailed description of the parameters:
   - **Project Name**: name of the project (for example**MortgageProject**).
   - **Project Description**: description of the project, which may be useful for the project documentation purposes.
   - **Group ID**: group ID of the project (for example**org.mycompany.commons**).
   - **Artifact ID**: artifact ID unique in the group (for example**myframework**). Avoid using a space or any other special character that might lead to an invalid name.

- **Version**: version of the project (for example **2.1.1**).

5. Click **Finish**.
   The project screen view is updated with the new project details as defined in the **pom.xml** file. You can switch between project descriptor files and edit their content by clicking the **Project Settings: Project General Settings** button at the top of the project screen view.

Creating a Project Using the REST API

IMPORTANT

Note that only users with the **rest-all** or **rest-project** role can create projects.

To create a project in the repository, issue the **POST** REST API call. Details of the project are defined by the corresponding JSON entity.

Input parameter of the call is an **Entity** instance. The call returns a **CreateProjectRequest** instance.

Example 3.4. Creating a Project Using the Curl Utility

Example JSON entity containing details of a project to be created:

```
{
 "name"        : "MortgageProject",
 "description" :  null,
 "groupId"     : "org.mycompany.commons",
 "version"     : "2.1.1"
}
```

Execute the following command:

```
curl -X POST 'localhost:8080/business-
central/rest/repositories/REPOSITORY_NAME/projects/' -u
USERNAME:PASSWORD -H 'Accept: application/json' -H 'Content-Type:
application/json' -d
'{"name":"MortgageProject","description":null,"groupId":"org.mycompany.c
ommons","version":"2.1.1"}'
```

For further information, see the *Red Hat JBoss BPM Suite Development Guide*, chapter *Knowledge Store REST API*, section *Repository Calls*.

3.5. CREATING A NEW PACKAGE

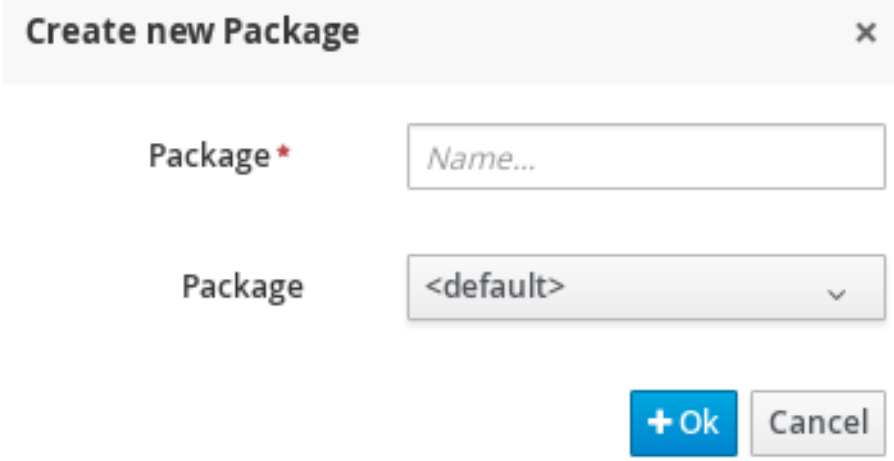
It is possible to create a new package in the **Project Authoring** perspective of Business Central.

Procedure: Creating a New Package in Business Central

1. In Business Central, go to **Authoring → Project Authoring**.

2. In the **Project Explorer** view, select the organizational unit, repository and the project where you want to create the package.

3. On the perspective menu, click **New Item** → **Package**.
The **Create new Package** dialog window opens.



4. Define the package details: enter the package name a specify the package.

5. Click **Ok**.
A new package is now created under the selected project.

3.6. ADDING DEPENDENCIES

To add dependencies to your project, do the following:

1. Open the Project Editor for the given project:

   a. In the **Project Explorer** view of the *Project Authoring* perspective, open the project directory.

   b. Click **Open Project Editor** to open the project view.

2. In the **Project Screen** view, select in the **Project Settings** drop-down box the **Dependencies** item.

3. On the updated **Project Screen**, click the **Add** button to add a maven dependency or click the **Add from repository** button to add a dependency from the Knowledge Store (Artifact repository):

   a. When adding a maven dependency, a user has to define the **Group ID**, **Artifact ID** and the **Version ID** in the **Dependency** dialogue window.

   b. When adding a dependency from the Knowledge Store, select the dependency in the displayed dialog box: the dependency will be added to the dependency table.

4. To apply the various changes, the dependencies must be saved.

Additionally, you can use the **Package white list** when working with dependencies. When you add a repository, you can click the gear icon and select **Add all** or **Add none**, which results in including all or none of the packages from the added dependency.

WARNING

If working with modified artifacts, do not re-upload modified non-snapshot artifacts as Maven will not know these artifacts have been updated, and it will not work if it is deployed in this manner.

3.7. DEFINING KIE BASES AND SESSIONS

A *KIE base* is a repository of the application's knowledge definitions. It contains rules, processes, functions, and type models. A KIE base does not contain runtime data, instead sessions are created from the KIE base into which data can be inserted and process instances started.

A *KIE session* stores runtime data created from a KIE base. See theKIE Sessions chapter of the *Red Hat JBoss BPM Suite Development Guide*for more information.

You can create KIE bases and sessions by editing the **`kmodule.xml`** project descriptor file of your project.You can do so through Business Central or by editing **`kmodule.xml`** in the **`src/main/resources/META-INF/`** folder by navigating through the**`Repository`** view.

Defining KIE Bases and Sessions in the Project Editor

To define a KIE base or session in Business Central, do the following:

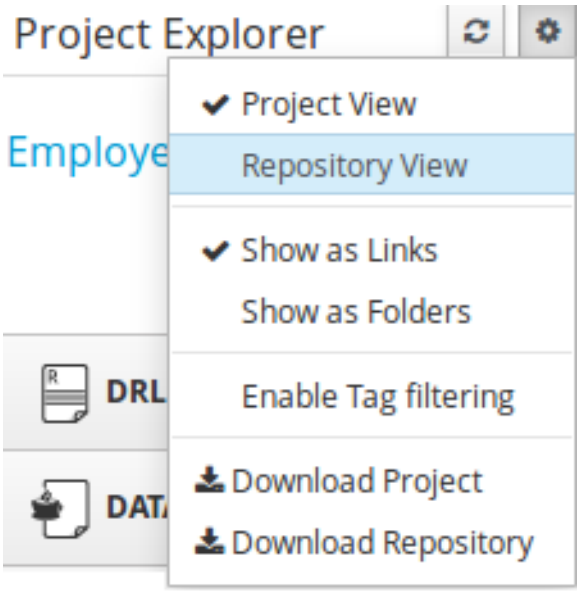
1. Click **Authoring** → **Project Authoring** and navigate to your project.
2. In the **Project Explorer** window, click **Open Project Editor**.
3. Click **Project Settings: Project General Settings** → **Knowledge bases and sessions**. This view provides a user interface for changing**`kmodule.xml`**.
4. Click **Add** to define and add your bases.
    a. After you enter a name for your Knowledge Base, add Packages. For including all packages, click **Add** below **Packages** and enter asterisk *****.
5. Below **Knowledge Sessions**, click **Add** and enter the name of your session.
6. Mark it **`Default`** and select appropriate state.
   For Red Hat JBoss BRMS, you can choose between **`stateful`** and **`stateless`** sessions. Use **`stateless`** if you do not need iterative invocations of the facts. Otherwise, use **`stateful`** session.
7. Click **Save** in the top right corner once you are done.

Defining KIE Bases and Sessions in kmodule.xml

To define a KIE base or session by editing **`kmodule.xml`**, do the following:

1. Open the repository view for your project.

Figure 3.4. Changing to Repository View



2. Navigate to **/src/main/resources/META-INF** . Click on **kmodule.xml** to edit the file directly.

3. Define your **kbases** and **ksessions**. For example:

```
<kmodule xmlns="http://www.drools.org/xsd/kmodule"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <kbase name="myBase" default="true" eventProcessingMode="stream"
equalsBehavior="identity" packages="*">
    <ksession name="mySession" type="stateless" default="true"
clockType="realtime"/>
  </kbase>
</kmodule>
```

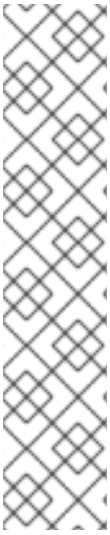
4. Click **save** in the top right corner.

You can switch between the Project Editor view and the Repository view to look at the changes you make in each view. To do so, close and reopen the view each time a change is made.

3.8. CREATING A RESOURCE

A Project may contain an arbitrary number of packages, which contain files with resources, such as Process definition, Work Item definition, Form definition, Business Rule definition, etc.

To create a resource, select the Project and the package in the **Project Explorer** and click **New Item** on the perspective menu and select the resource you want to create.



CREATING PACKAGES

It is recommended to create your resources, such as Process definitions, Work Item definitions, Data Models, etc., inside a package of a Project to allow importing of resources and referencing their content.

To create a package, do the following:

- In the **Repository** view of the Project Explorer, navigate to the **`REPOSITORY/PROJECT/src/main/resources/`** directory.
- Go to **New Item** → **Package**.
- In the **New resource** dialog, define the package name and check the location of the package in the repository.

CHAPTER 4. SOCIAL EVENTS

In Red Hat JBoss BRMS, users can follow other users and gain an insight into what activities are being performed by those users. They can also listen for and follow timelines of regular events. This capability comes via the implementation of a Social Activities framework. This framework ensures that event notifications are generated by different activities within the system and that these notifications are broadcast for registered actors to view.

Multiple activities trigger events. These include: new repository creation, adding and updating resources and adding and updating processes. With the right credentials, a user can view these notifications once they are logged into Business Central.

Follow User

To follow a user, search for the user by entering his name in the search box in the **People** perspective. You get to this perspective by navigating to it from **Home** → **People**.

You must know the login name of the other user that you want to follow. As you enter the name in the search box, the system will try and auto-complete the name for you and display matches based on your partial entry. Select the user that you want to follow from these matches and the perspective will update to display more details about this user.

You can choose to follow the user by clicking on the **Follow** button. The perspective refreshes to showcase the user details and their recent activities.

Activity Timeline

Click on **Home** → **Timeline** to see a list of recent assets that have been modified (in the left hand window) and a list of changes made in the selected repository in the right hand side. You can click on the assets to directly open the editor for the assets (if you have the right permissions).

CHAPTER 5. DATA MODELS

Data models are models of data objects. A data object is a custom complex data type (for example, a Person object with data fields Name, Address, and Date of Birth).

Data models are saved in data models definitions stored in your Project. Red Hat JBoss BRMS provides the Data modeler, a custom graphical editor, for defining data objects.

5.1. DATA MODELER

The Data Modeler is the built-in editor for creating facts or data objects as part of a Project data model from the Business Central. Data objects are custom data types implemented as POJOs. These custom data types can be then used in any resource (such as a Guided Decision Table) after they have been imported.

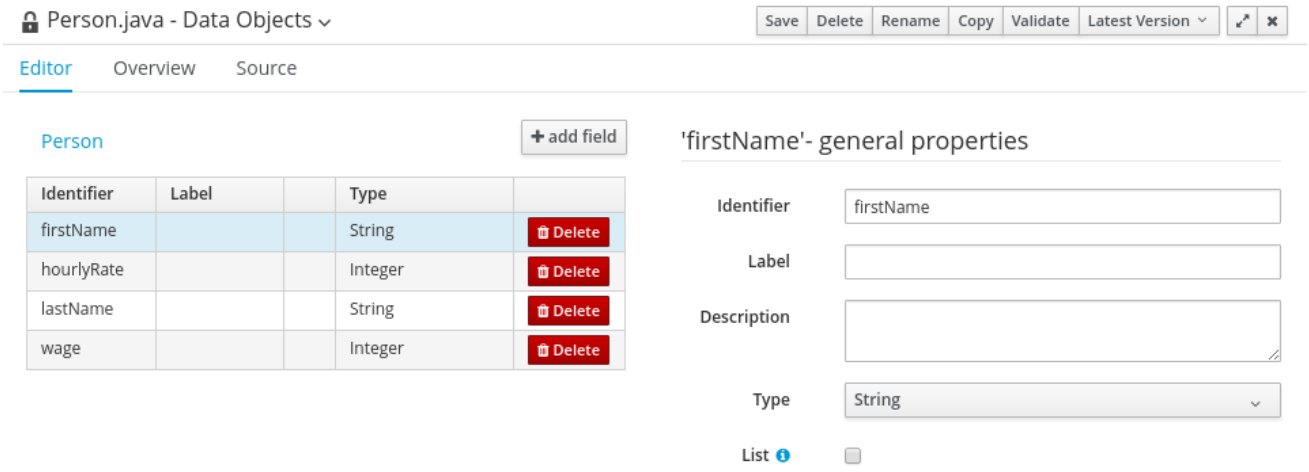
To open the editor, open the Project Authoring perspective, click **New Item** → **Data Object** on the perspective menu. If you want to edit an existing model, these files are located under **Data Objects** in **Project Explorer**.

You will be prompted to enter the name of this model object when creating a new model, and asked to select a location for it (in terms of the package). On successful addition, it will bring up the editor where you can create fields for your model object.

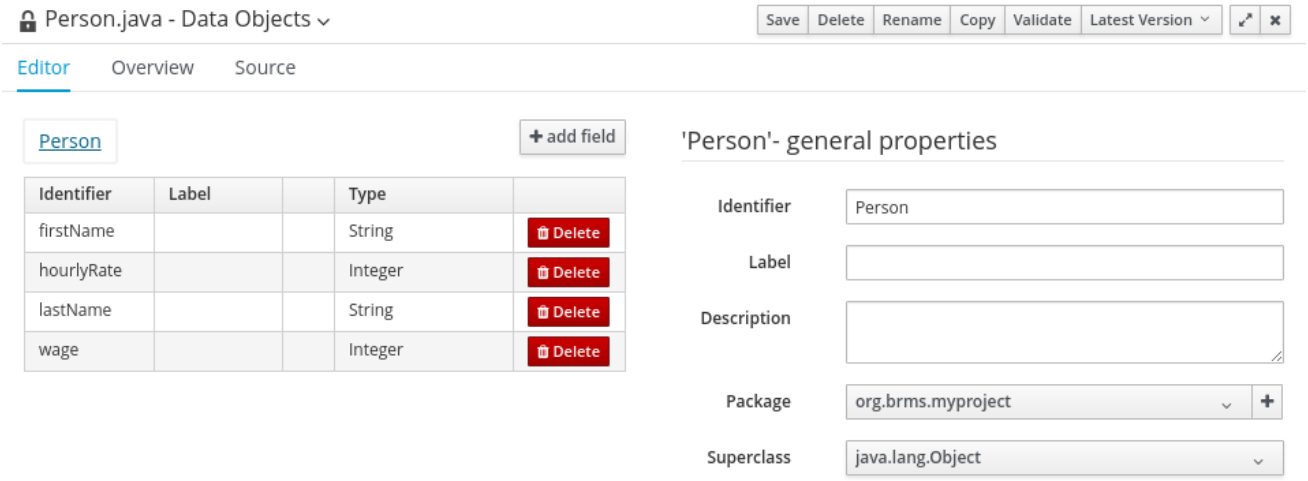
The Data Modeler supports roundtrips between the **`Editor`** and **`Source`** tabs, along with source code preservation. This allows you to make changes to your model in external tools, like JBDS, and the Data Modeler updates the necessary code blocks automatically.

In the main editor window the user can

- Add/delete fields
- Select a given field. When a field is selected then the field information will be loaded in all the domain editors.



- Select the data object class. For example, by clicking on the data object name (on the main window) instead of loading the field properties, the domain editors will load the class properties.



5.2. ANNOTATIONS IN DATA MODELER

Red Hat JBoss BRMS supports all Drools annotations by default, and can be customized using the **Drools & jBPM** domain screen. For further information about available domain screens, see Section 5.5, “Data Object Domain Screens”.

If you want to add/edit custom or pre-defined annotations, you can switch to the source tab and modify the source code directly (in Red Hat JBoss Developer Studio or Business Central). You can also use the **Advanced** screen to manage arbitrary annotations.

When creating or adding fields to a persistable data object, the JPA annotations that are added by default will generate a model that can be used by Red Hat JBoss BRMS at runtime. In general, modifying the default configurations where the model will be used by processes is not recommended.

Red Hat JBoss BRMS 6.2 onwards supports the use of JPA specific annotations, with Hibernate available as the default JPA implementation. Other JPA annotations are also supported where the JPA provider is loaded in the classpath.

NOTE

When adding an annotation in the Data Modeler, the annotation class should be on the workbench classpath, or a project dependency can be added to a `.jar` file that has the annotation. The Data Modeler will run a validation check to confirm that the annotation is on the classpath, and the project will not build if the annotation is not present.

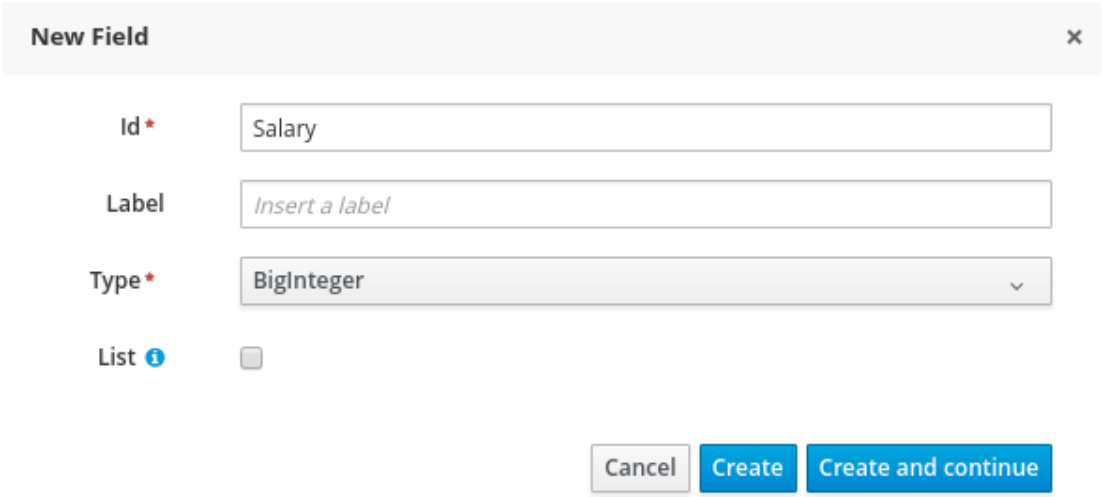
5.3. CREATING DATA OBJECT (NOT PERSISTABLE)

1. In the Project Authoring perspective, click **New Item** → **Data Object** on the perspective menu. Enter the name and select the package (the name must be unique across the package, but it is possible to have two data object with the same name in two different packages). Uncheck the **Persistable** box to prevent the Data Object from being made persistable. Click **Ok**.

2. Create fields of the data object:

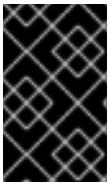
    a. By clicking **add field** button in the main editor window, you can add a field to the object with the attributes **Id**, **Label** and **Type**. Required attributes are marked with *.

- **Id**: field ID unique within the data object
- **Label**: label to be used in the**Fields** panel (optional)
- **Type**: data type of the field



b. Click the **Create** button (the new field is created and the**New field** window closes) or the **Create and continue** button (the new field is created and the **New field** window remains open, so it is possible to continue adding more fields).

Attributes can be edited selecting the attribute and editing the fields using the general properties screen to the right.



USING A DATA OBJECT

To use a data object, make sure you import the data model into your resource. This is necessary even if the data model lives in the same Project as your resource (Business Process).

5.4. PERSISTABLE DATA OBJECTS

From Red Hat JBoss BRMS 6.2 onwards, the Data Modeler is extended to support the generation of persistable Data Objects by checking the **Persistable** check box on the perspective menu when you create a new Data Object. Persistable Data Objects are based on the JPA specification. When the **Persistable** check box is selected when the object is created, the platform will set some configurations required for persistence by default. The object can also be made persistable after the object has already been created. This can then be customized as required.

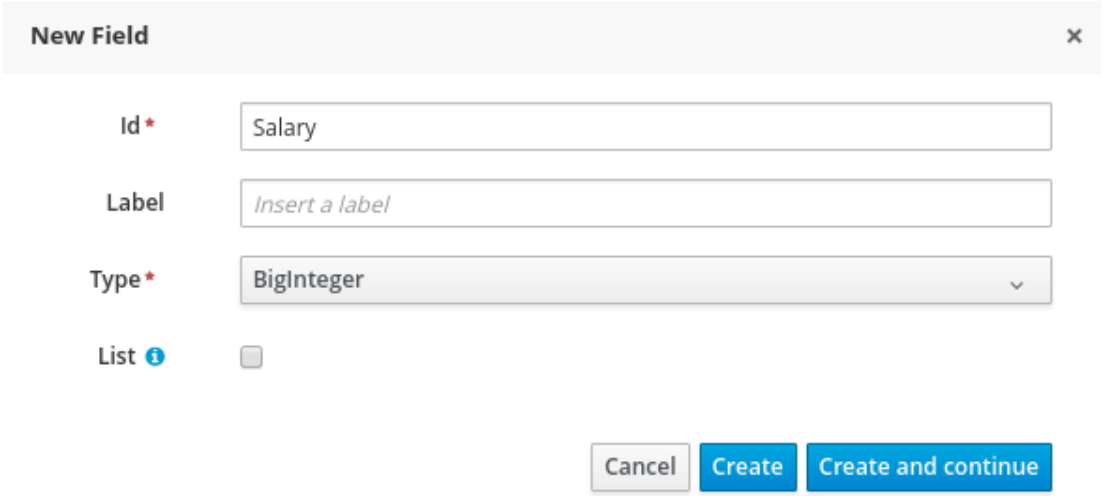
Procedure: Creating a Persistable Data Object

1. When creating a persistable Data Object, the Identifier field **`id`** will be generated automatically, along with the **`@Entity`** annotation.
   Selecting the **List** option changes a property to have multiple values. For example, it can enable an attribute **`Name`**, to have a list of strings with multiple names.

2. Create fields of the data object:

a. By clicking **add field** button in the main editor window, you can add a field to the object with the attributes **Id**, **Label** and **Type**. Required attributes are marked with *.

- **Id**: field ID unique within the data object
- **Label**: label to be used in the**Fields** panel (optional)
- **Type**: data type of the field



b. Click the **Create** button (the new field is created and the**New field** window closes) or the **Create and continue** button (the new field is created and the **New field** window remains open, so it is possible to continue adding more fields).

Attributes can be edited selecting the attribute and editing the fields using the general properties screen to the right.

5.5. DATA OBJECT DOMAIN SCREENS

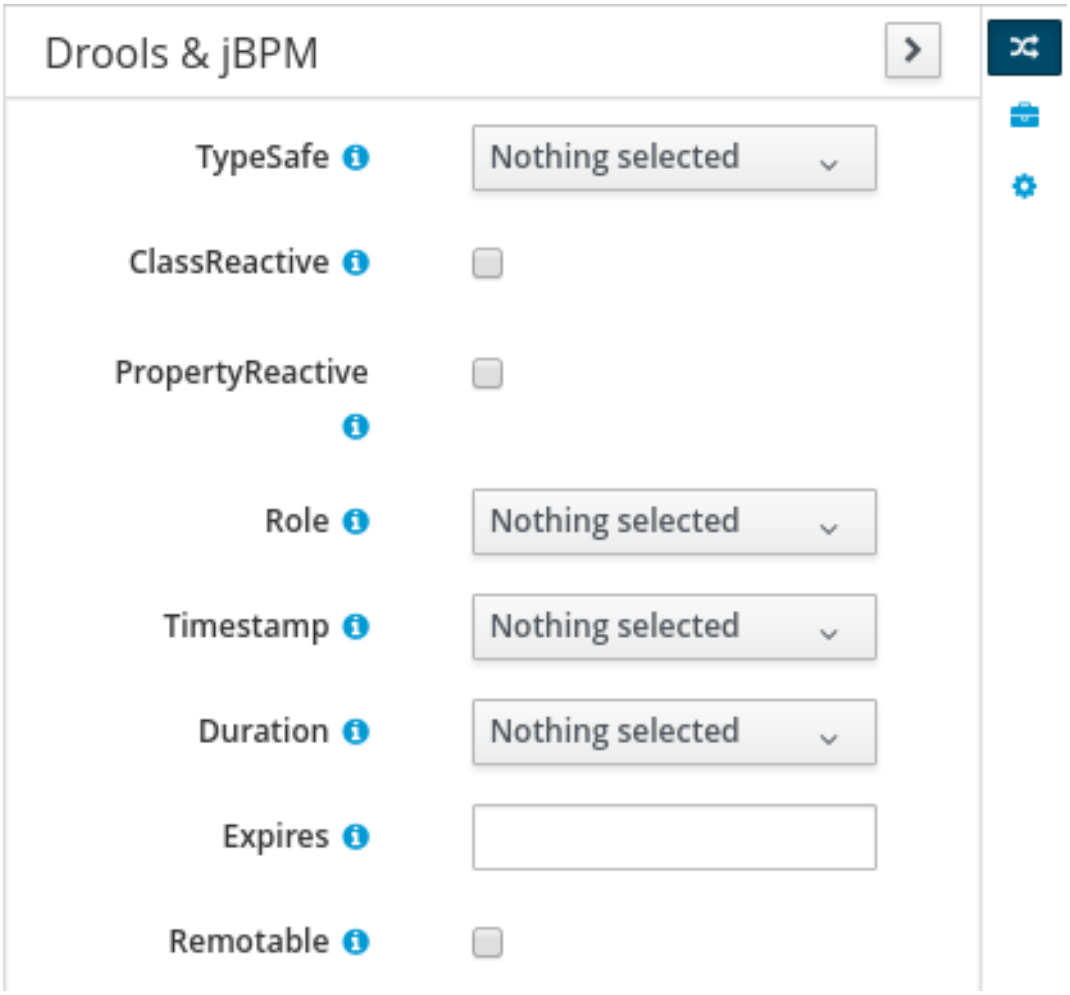
The following domain screen tabs can be selected from the right side of the Data Object editor screen.

Drools & jBPM

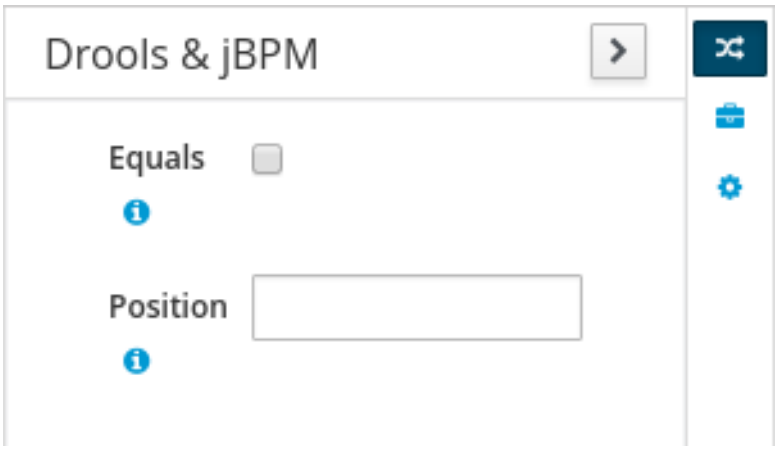
The **Drools & jBPM** screen allows configuration of Drools-specific attributes.

The Data Modeler in Business Central supports the editing of pre-defined annotations of fact model classes and attributes. The following Drools annotations are supported, and can be customized using the **Drools & jBPM** interface:

- **`TypeSafe`**
- **`Role`**
- **`Timestamp`**
- **`Duration`**
- **`Expires`**

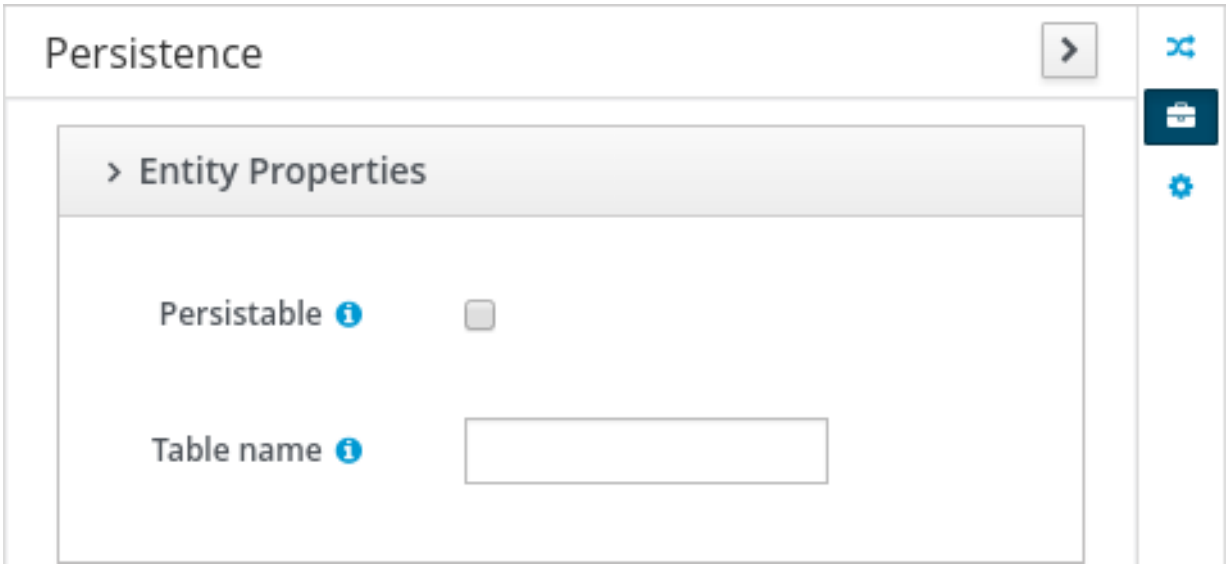


For the fields within the fact model, the **`position`** annotation is supported. The**Drools & jBPM** screen when a specific field is selected looks as follows:

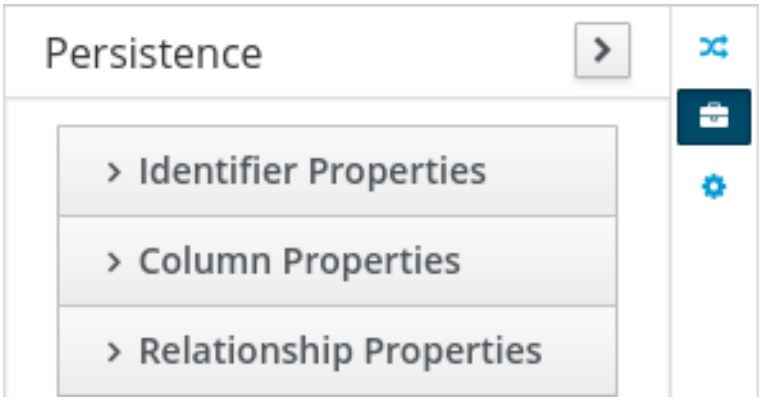


Persistence

The **Persistence** screen can be used to configure attributes on basic JPA annotations for persistence. Fine tuning of annotations, or to add specific annotations, use the **Advanced** screen.



The **Persistence** screen when a specific field is selected looks as follows:



The following annotations can be managed via the **Persistence** screen.

Table 5.1. Type Annotations

Annotation	Automatically Generated when Data Object is Persistable
javax.persistence.Entity	Yes
javax.persistence.Table	No

Table 5.2. Field Annotations

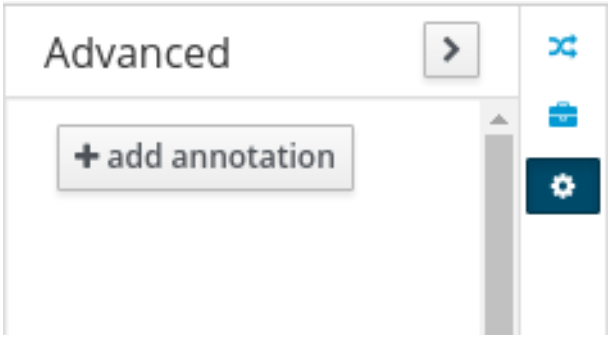
Annotation	Automatically Generated when Data Object is Persistable
javax.persistence.Id	Yes
javax.persistence.GeneratedValue	Yes

Annotation	Automatically Generated when Data Object is Persistable
javax.persistence.SequenceGenerator	Yes
javax.persistence.Column	No
javax.persistence.OneToOne	No
javax.persistence.OneToMany	Yes - when a field has one or multiple values
javax.persistence.ManyToOne	Yes - when a field has multiple values
javax.persistence.ManyToMany	No
javax.persistence.ElementCollection	Yes - generated by the UI when a new field has one or multiple of a base java type, such as Integer, Boolean, String. This annotation cannot be edited with the **Persistence** screen tool (use the **Advanced** screen tool instead).

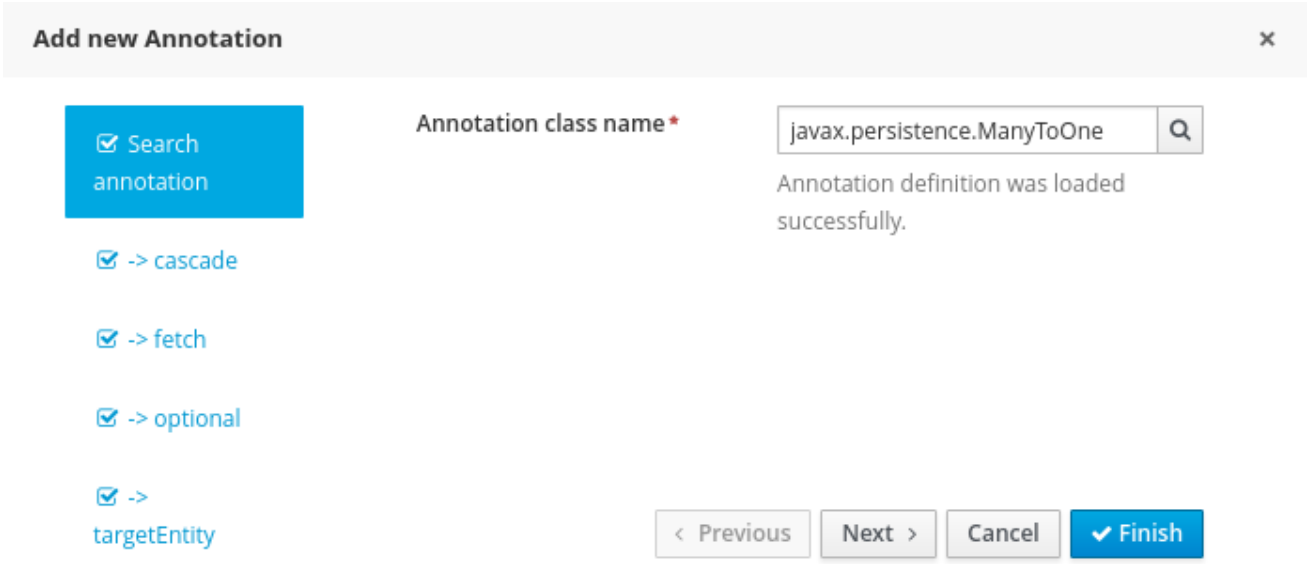
All other JPA annotations can be added using the **Advanced** screen.

Advanced

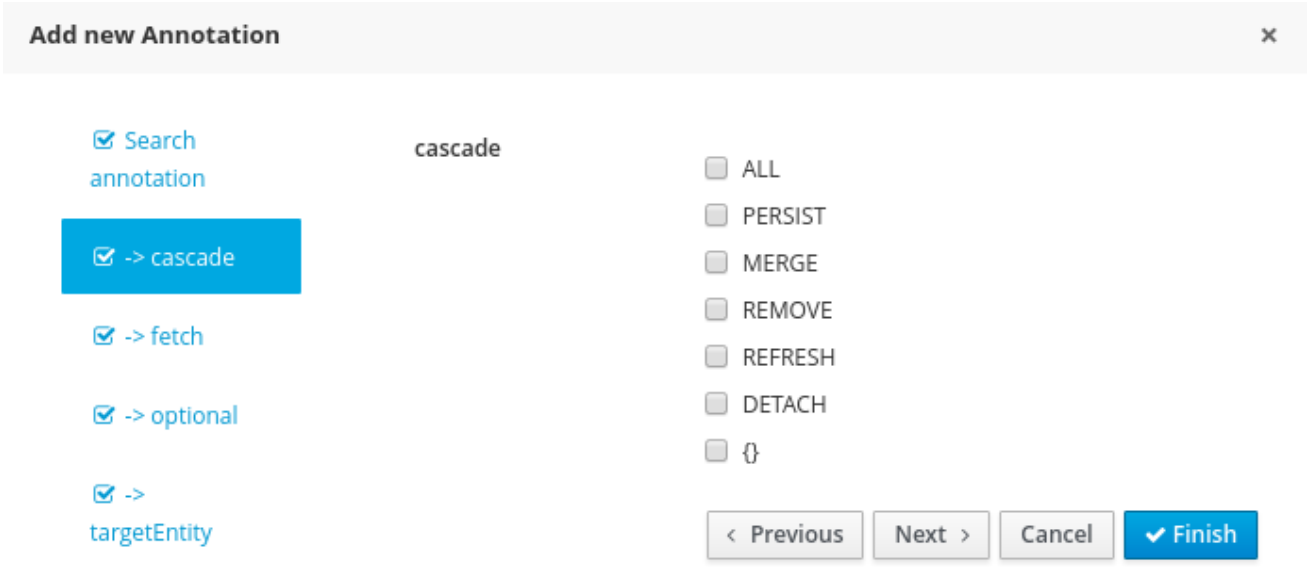
The **Advanced** screen is used for fine-tuning of annotations. Annotations can be configured, added and removed using the Advanced Domain screen. These can be any annotation that is on the classpath.



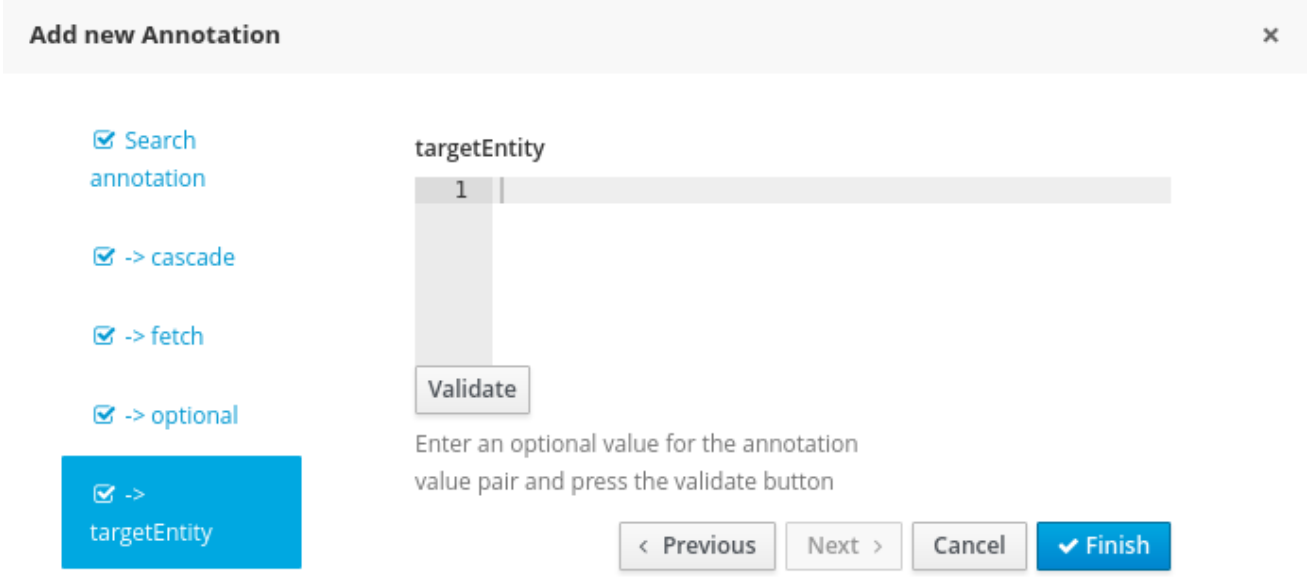
After you click on the **add annotation** option, the **Add new Annotation** window is displayed. It is required to enter a fully qualified class name of an annotation and by pressing the **search** icon, the annotation definition is loaded into the wizard. Then it is possible to set different annotation parameters (required parameters are marked with *).



If possible, the wizard will provide a suitable editor for the given parameters.



If it is not possible to provide a customized editor, the wizard will provide a generic parameter editor.



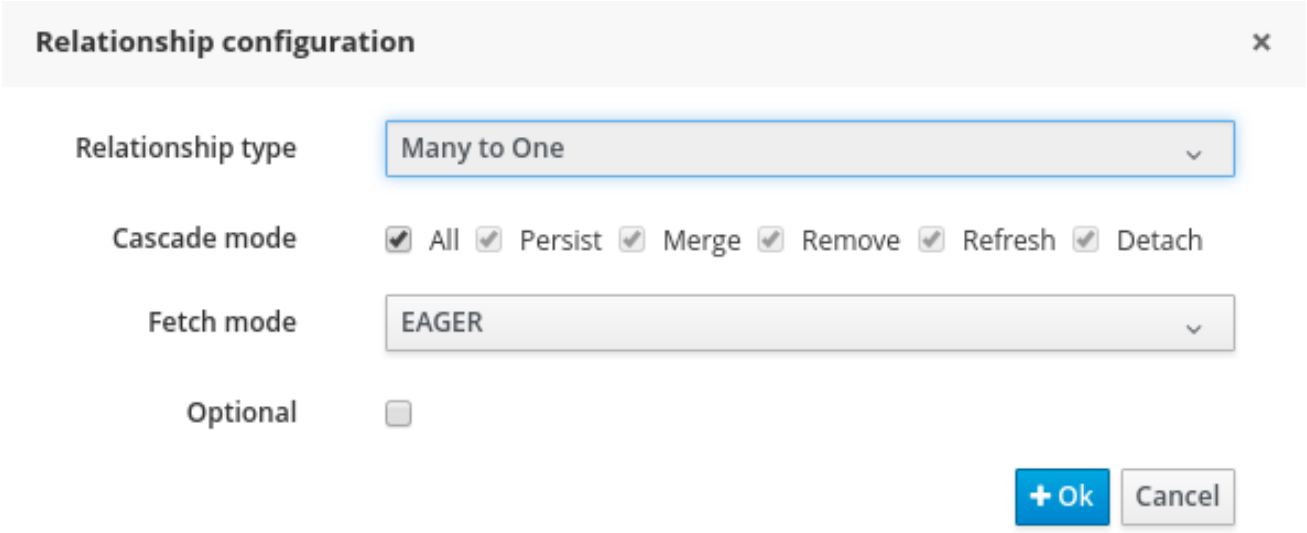
After you enter all the required parameters, the **Finish** button is enabled and the annotation can be added to the given field or data object.

5.6. CONFIGURING RELATIONSHIPS BETWEEN DATA OBJECTS

When an attribute type is defined as another Data Object, the relationship is identified and defined by the symbol in the object attribute list. You can jump to the Data Object definition to view and edit by clicking on the icon.

Relationship customization is only relevant where the data object is persistable.

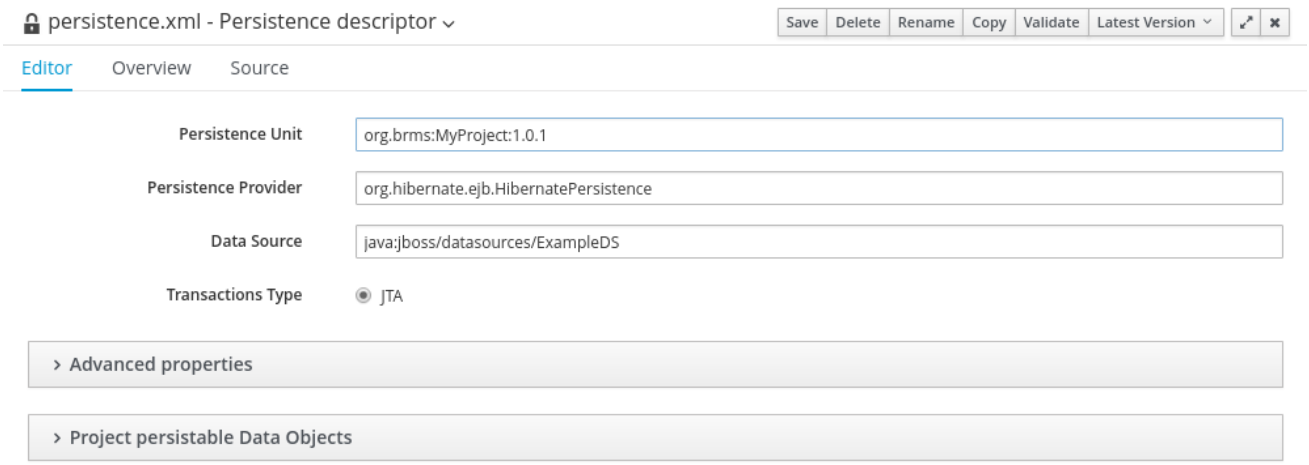
Relationships can be configured by selecting an attribute with a relationship and choosing the **Persistence** button on the right. Under**Relationship Properties**, click the **Relationship Type** property editing option.



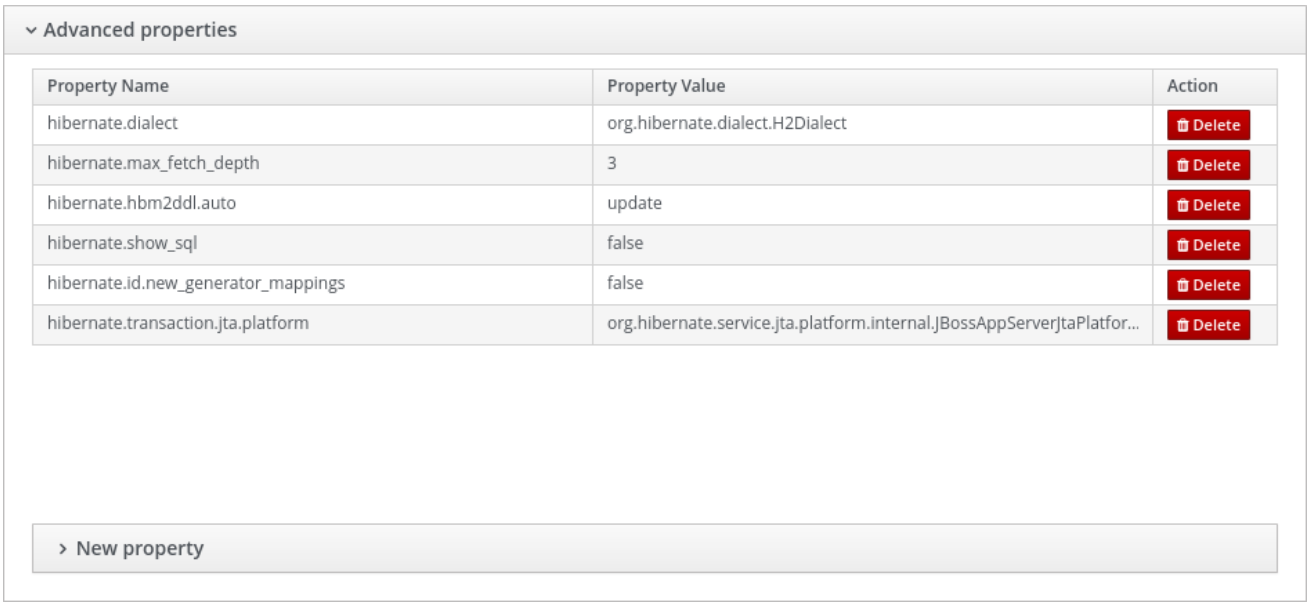
Attempting to delete a Data Object that has a relationship with another Data Object will show the **Usage Detected** screen. It is still possible to delete the object from here, however this will stop your project from building successfully until the resulting errors are resolved.

5.7. PERSISTENCE DESCRIPTOR

When creating persistent data objects, the **`persistence.xml`** file is created by default when the user opens the project editor and selects **Persistence Descriptor**. It can then be configured via the Persistence Descriptor. The Persistence Descriptor is accessible by opening the Project Editor, and clicking **Project Settings: Project General Settings → Persistence descriptor**.

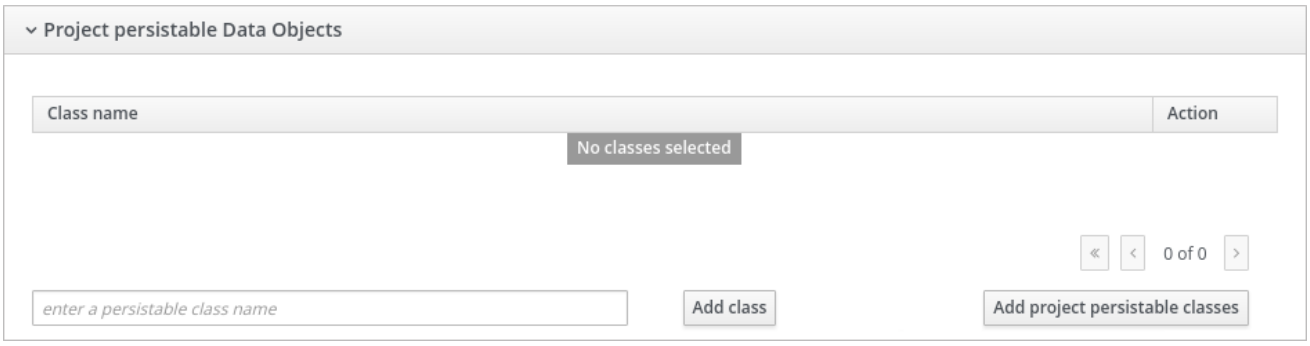


In the **Advanced properties** section, it is possible to change or delete all the properties generated by default and add new ones as well.



If you open the **Project persistable Data Objects** section in the Persistence Descriptor, you will see two buttons:

- **Add class** enables the user to add arbitrary classes to the**`persistence.xml`** file to be declared as entities.
- **Add project persistable classes** will automatically load all the persistable data objects in the current project.



5.8. DATA SETS

The data set functionality in Business Central defines how to access and parse data. Data sets serve as a source of data that can be displayed by the Dashbuilder displayer. You can add the Dashbuilder displayers to a custom perspective in the Plugin Management perspective. Note that the data set perspective is visible only to users of the Administrator group.

5.8.1. Managing Data Sets

To add a data set definition:

1. Log into Business Central and click **Extensions** → **Data Sets**.
2. Click **New Data Set**.
3. Select the provider type and click **Next**. Currently, the following provider types are supported:
   - Java Class – generate a data set from a Java class.
   - SQL – generate a data set from an ANSI-SQL compliant database.
   - CSV – generate a data set from a remote or local CSV file.
   - Elastic Search – generate a data set from Elastic Search nodes.
4. Complete the **Data Set Creation Wizard** and click **Test**.
5. Depending on what provider you chose, the configuration steps will differ. Once you complete the steps, click **Save** to create a data set definition.

To edit a data set:

1. Log into Business Central and click **Extensions** → **Data Sets**.
2. In **Data Set Explorer**, click on an existing data set and click **Edit**.
3. **Data Set Editor** opens. You can edit your data set in three tabs. Note that some of the tabs differ based on the provider type you chose. The following applies to the *CSV* data provider.
   - **CSV Configuration** – allows you to change the name of your data set definition, the source file, the separator, and other properties.
   - **Preview** – after you click **Test** in the **CSV Configuration** tab, the system executes the data set lookup call and if the data is available, you will see a preview. Notice two subtabs:
     - **Data columns** – allows you to customize what columns are part of your data set definition.
     - **Filter** – allows you to add a new filter.
   - **Advanced** – allows you to manage:
     - Caching – see Section 5.8.2, “Caching” for more information.

- Cache life-cycle – see Section 5.8.3, “Data Refresh” for more information.

5.8.2. Caching

Red Hat JBoss BRMS data set functionality provides two cache levels:

- Client level
- Back end level

Client Cache
When turned on, the data set is cached in a web browser during the look-up operation. Consequently, further look-up operations do not perform any request to the backend.

Backend Cache
When turned on, the data set is cached by the Red Hat JBoss BRMS engine. This reduces the number of requests to the remote storage system.

NOTE

The Java and CSV data providers rely on back-end caching. As a result, back-end cache settings are not always visible in the **Advanced** tab of the **Data Set Explorer**.

5.8.3. Data Refresh

The refresh features allow you to invalidate cached data set data after a specified interval of time. The **Refresh on stale data** feature invalidates cached data when the back-end data changes.

CHAPTER 6. WRITING RULES

6.1. CREATING A RULE

Procedure: Creating a new rule

1. In the **Project Explorer** view, do the following:
   a. If in the Project view of Project Explorer, select the organizational unit, repository and the project where you want to create the rule.
   b. If in the Repository view of Project Explorer, navigate to src/main/resources/ and the SUBFOLDER/PACKAGE where you want to create the project folder for the rule template.
2. In the perspective menu, go to **New Item** → **Guided Rule**.
3. In the **Create new Guided Rule** dialog window, define the package details:
   - In the **Resource Name** text box, enter the Guided Rule name and click **OK**.
4. The new Guided Rule is now created under the selected project.

6.2. THE ASSET EDITOR

6.2.1. The Asset Editor

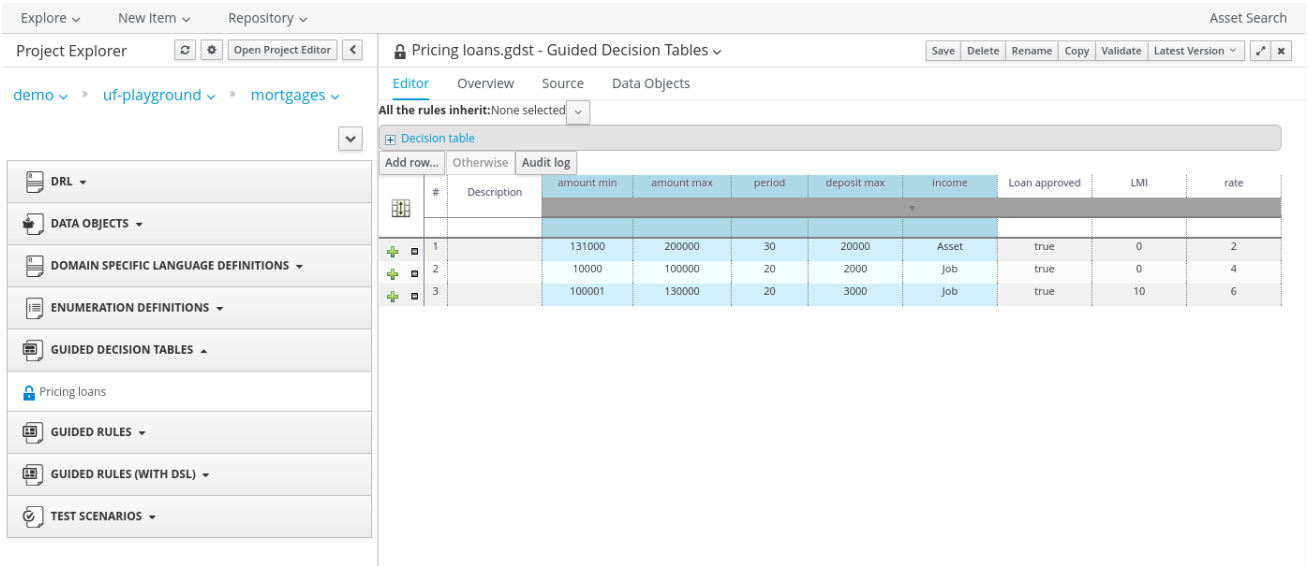
The asset editor provides access to information about assets and gives users the ability to edit assets.

The editor contains **Editor**, **Overview**, **Source**, and **Data Objects** tabs.

Editor tab

The **Editor** tab is where assets can be edited. The available options in the edit tab will depend on the type of asset being edited.

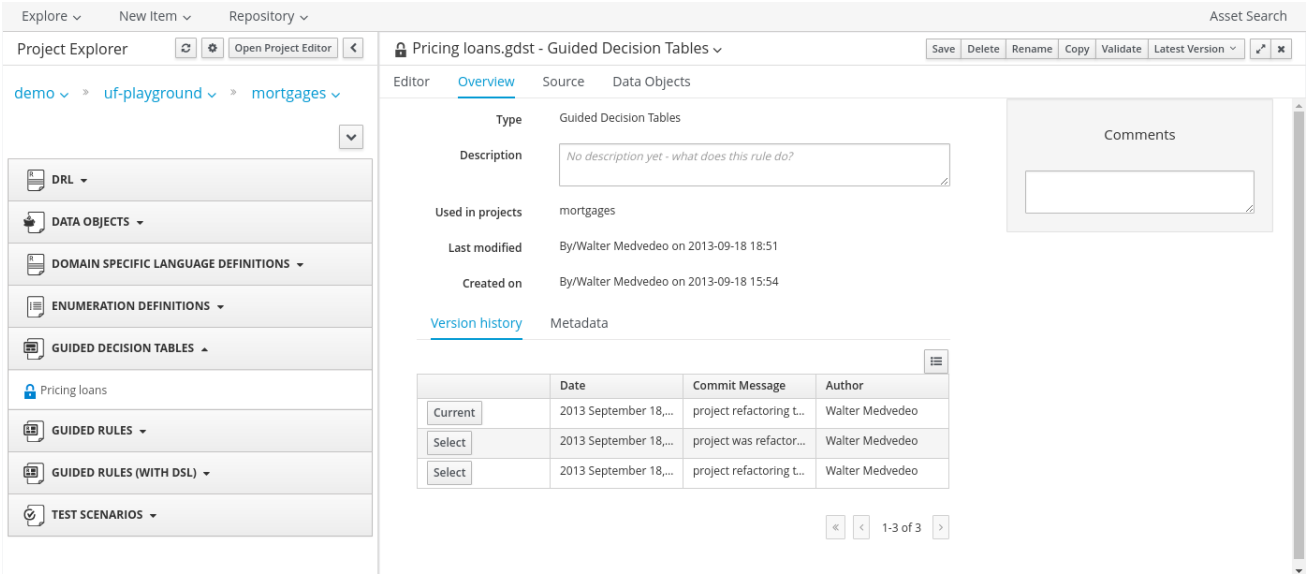
Figure 6.1. The Asset Editor - Edit tab



Overview tab

The Overview screen displays the generic data and version history of an asset. It allows a user to edit other metadata details, add descriptions and discussions which are specific to a selected asset.

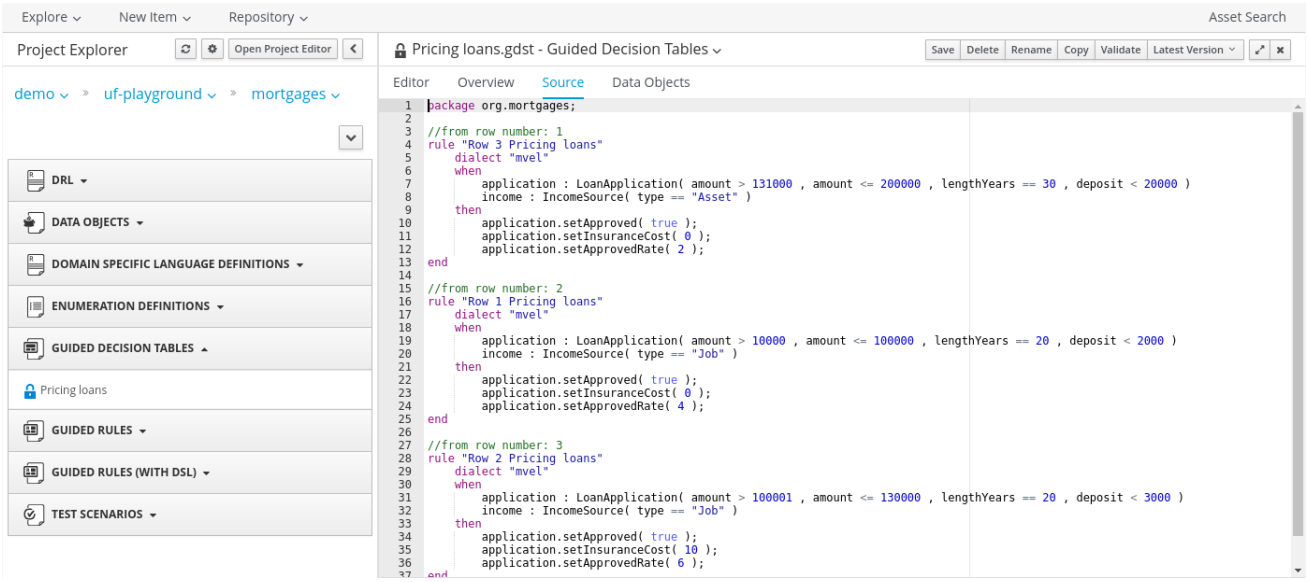
Figure 6.2. The Asset Editor - Overview tab



Source tab

Source tab shows the DRL source for a selected asset.

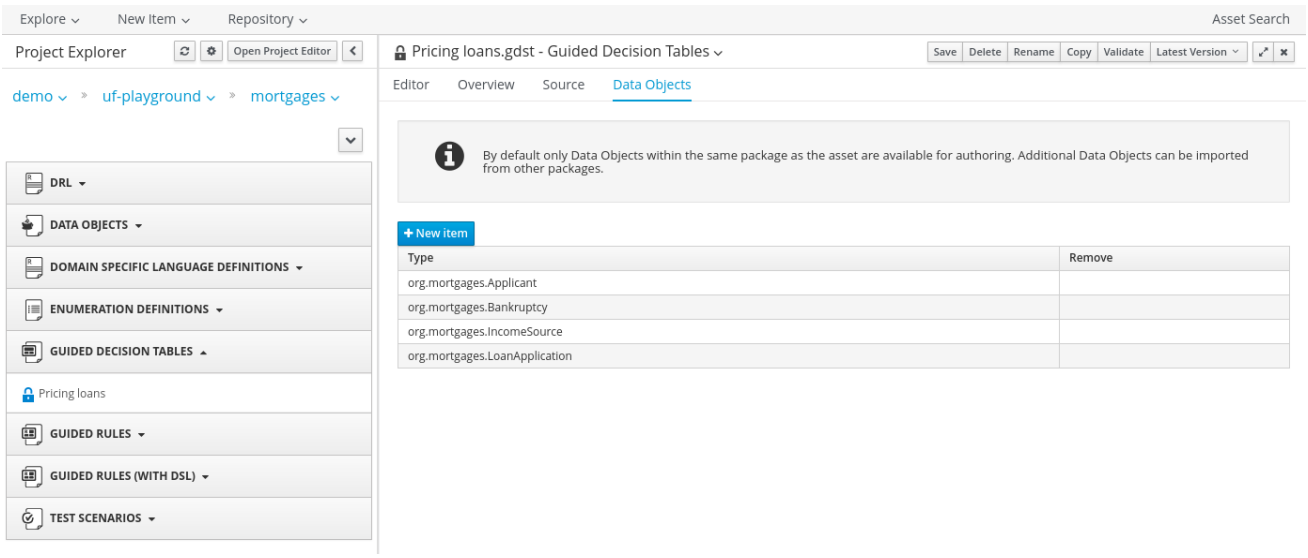
Figure 6.3. The Asset Editor - Source tab



Data Objects Tab

The Data Objects tab suggests the set of imports used in the project. Each asset has its own imports and suggest fact types that the user might want to use.

Figure 6.4. The Asset Editor - Data Objects tab

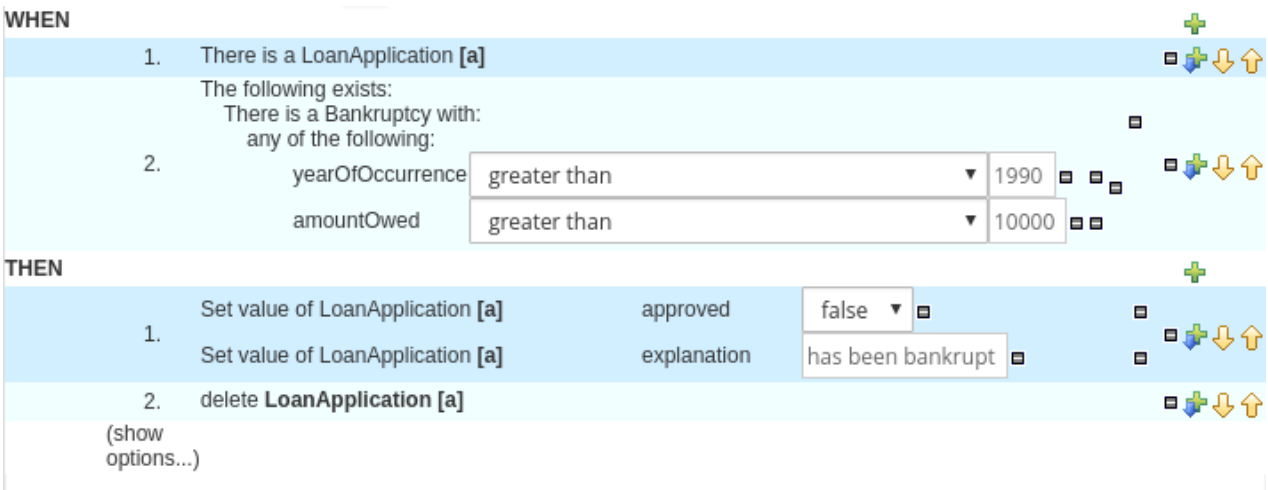


6.2.2. Business rules with the guided editor

Business rules are edited in the guided editor. Rules edited in the guided editor use the Business Rules Language (**BRL**) format. The guided editor prompts users for input based on the object model of the rule being edited.

A package must exist for assets to be added to before rules can be created. Package access must be configured before users can use the **BRL** guided editor.

Example 6.1. The guided editor



6.2.3. Narrowing Facts Using Package White List

You can narrow down the facts available during rule creation and modification by using a file called **`package-names-white-list`**. This file allows you to narrow down a group of facts that are loaded and are visible. This helps to speed up the loading of these facts while creating new rules.

When you create a new project in the root directory, an empty **`package-names-white-list`** file is automatically created along with the **`pom.xml`** and **`project.imports`** project files. For existing projects, you need to create this file manually. In Business Central, you can view

this file through the repository view of a project in the **Project Explorer**.

By default (when the file is empty), all the facts within the project itself are visible while those from the project's dependencies are restricted.

Rules for Defining Packages
The **package-names-white-list** file is a text file that accepts single package names on each line. Packages can contain wildcards as defined below:

- com.redhat.finance: allows facts from *only* the com.redhat.finance package. Thus, **com.redhat.finance.Person** and **com.redhat.finance.Salary** are allowed, but **com.redhat.finance.senior.Management** are not allowed.
- com.redhat.finance.*: allows facts from the sub-packages of the com.redhat.finance package *only*. Thus, **com.redhat.finance.senior.Management** and **com.redhat.finance.junior.Management** are allowed, but *not* **com.redhat.finance.Person**.
- com.redhat.finance.**: this is a combination of the above two rules. Allows **com.redhat.finance.Person** and **com.redhat.finance.senior.Management** and even, **com.redhat.finance.really.senior.Management** classes.

You can include specific packages from a dependency by adding appropriate entries into the **package-names-white-list** file. You can also include or remove all packages from specific dependencies. For more information, see Adding Dependencies.

6.2.4. The Anatomy of a Rule

A rule consists of multiple parts:

When

The *When* part of the rule is the condition that must be met. For instance, a bank providing credit in the form of a loan may specify that customers must be over twenty-one years of age. This would be represented by using *when* to determine if the customer is over twenty-one years of age.

Then

The *Then* part of the rule is the action to be performed when the conditional part of the rule has been met. For instance, *when* the customer is under twenty-one years of age, *then* decline the loan because the applicant is under age.

Optional

Optional attributes such as salience can be defined on rules.

With the guided editor, it is possible to add more conditions to the When (or conditional) part of the rule and more actions to the Then (or action) part of the rule. For instance, if an applicant under the age of 21 had a guarantor for a loan application, the bank may decide to approve the loan application.

6.2.5. Salience

Each rule has a salience value which is an integer value that defaults to zero. The salience value represents the priority of the rule with higher salience values representing higher priority. Salience values can be positive or negative.

6.2.6. Adding Conditions or Actions to Rules

Procedure: Adding Conditions or Actions to Rules

1. Click the plus icon in the When section of the guided editor to add a condition, or click the plus icon in the Then section of the guided editor to add an action.

2. Select the condition or action from the menu and click **Ok**. If the package the rule belongs to has been configured to include DSL (Domain Specific Language) sentences, DSL sentences can be chosen from the menu.

3. If the condition or action requires input, i.e., a date, true or false, am integer, or other input type, enter the required value.

6.2.7. Adding a Field to a Fact Type

With the guided editor, it is possible to add more conditions to the 'when' (or conditional) part of the rule and more actions to the 'then' (or action) part of the rule. For instance, if a loan applicant under the age of 21 had a guarantor for a loan application, the bank may decide to approve the loan application.

To add the guarantor to the condition, it is first necessary to add the **guarantor** field to the application fact type for the mortgage model.

Procedure: Adding a Field to a Fact Type

1. Select the Model
   From the Project Explorer, select the Project and expand the package that contains the model.

   Select and Open the model from the list by clicking over it.

2. Add the Field
   Expand the fact type by clicking the plus sign next to it and select **Add Field**.

3. Enter the Field Details
   Add the details to the pop up dialogue. In this case, enter the name *guarantor* in the **Field name** field and select **True or False** from the **Type** drop down menu.

   Save the changes made to the model by selecting **File** and **Save changes**.

With the guarantor field now added to the applicant fact type, it is possible to modify the rule to include a guarantor.

6.2.8. Technical Rules (DRL)

Technical (DRL) rules are stored as text and can be managed in the Red Hat Red Hat JBoss BRMS user interface. A DRL file can contain one or more rules. If the file contains only a single rule, then the package, imports and rule statements are not required. The condition and the action of the rule can be marked with "when" and "then" respectively.

Red Hat JBoss Developer Studio provides tools for creating, editing, and debugging DRL files, and it should be used for these purposes. However, DRL rules can be managed within the Red Hat JBoss BRMS user interface. The DRL editor provides syntax highlighting for Java, DRL, and XML.

Figure 6.5. Technical Rule (DRL)

```
Salience 100 #this can short circuit any processing
when
    a: Approve()
    p: Policy()
then
    p.setApproved(true);
    System.out.println("APPROVED:" + a.getReason());
```

6.3. DECISION TABLES

6.3.1. Spreadsheet Decision Tables

Rules can be stored in spreadsheet decision tables. Each row in the spreadsheet is a rule, and each column is either a condition, an action, or an option. The *Red Hat JBoss BRMS Development Guide* provides details for using decision tables.

6.3.2. Uploading Spreadsheet Decision Tables

Procedure: Uploading a Spreadsheet Decision Table

1. To upload an existing spreadsheet, select **New Item** → **Decision Table (Spreadsheet)**.

2. Enter a name for the spreadsheet and then click **Choose file...** button to browse and select the spreadsheet. You can only select **`.xls`** files. Click the **Ok** button when done.

To convert the uploaded spreadsheet to a Guided Decision table:

1. Validate the uploaded spreadsheet by clicking on the **Validate** button located on the project screen menu bar.

2. Now click on the **Other** drop down menu on the project screen toolbar and select the **Convert to Guided Decision Table** option.

6.3.3. Spreadsheet Decision Table Examples

We are here considering a simple example for an online shopping site which lists out the shipping charges for the ordered items. The site agrees for a FREE shipping with the following conditions:

- If the number of items ordered is 4 or more and totaling $300 or over and
- If delivered at the standard shipping day from the day they were purchased which would be 4 to 5 working days.

The listed shipping rates are as follows:

Table 6.1. For orders less than $300

Number of items	Delivery Day	Shipping Charge, N = Number of Items
3 or fewer	Next Day	$35
	2nd Day	$15
	Standard	$10
4 or more	Next Day	N*7.50
	2nd Day	N*3.50
	Standard	N*2.50

Table 6.2. For orders more than $300

Number of items	Delivery Day	Shipping Charge, N = Number of Items
3 or fewer	Next Day	$25
	2nd Day	$10
	Standard	N*1.50
4 or more	Next Day	N*5
	2nd Day	N*2
	Standard	FREE

The above conditions can be presented in a spreadsheet as:

Calculating Shipping Charges												
Purchase Amount	Over $300						Less than $300					
Number of Items	3 or less			4 or more			3 or less			4 or more		
Delivery Day	Next	2nd day	Standard	Next	2nd day	Standard	Next	2nd day	Standard	Next	2nd day	Standard
Shipping Charges ($)	25	10	N * 1.50	N * 5	N * 2	*FREE*	35	15	10	N * 7.50	N * 3.50	N * 2.50

Decision Tables can also be mapped based on actions and conditions as shown in the following format:

Conditions	Condition Alternatives
Actions	Action Entries

To explain the above format in detail we use a simple example of sending an email to a recipient with following conditions:

- Send an email when Recipient address is present, subject is present and before 5:30pm

- If after 5:30pm, then put it in the pending folder
- If Recipient address is missing, give a warning message
- If all fields are present and before 5:30, send the email

The Decision table can be mapped as follows:

Table 6.3. Decision Table Mapping

	Criteria		Mapped Entries		
Conditions (IF)	Address Present	Y	Y		Y
	Subject Present	Y		Y	Y
	Before 5:30	Y	Y	Y	
Actions (THEN)	Send Mail	X			
	Error Message		X	X	
	Make Pending				X

The above example is a limited-entry decision table where the condition alternatives are simple boolean values and the action entries are marked to represent which actions in the given columns are to be performed. For example if the condition alternatives are mapped for all 3 conditions - Address present, Subject Present and Before 5:30, the action entry is marked for action as Send Mail. So if all the three conditions are satisfied, the action will be to send the mail.

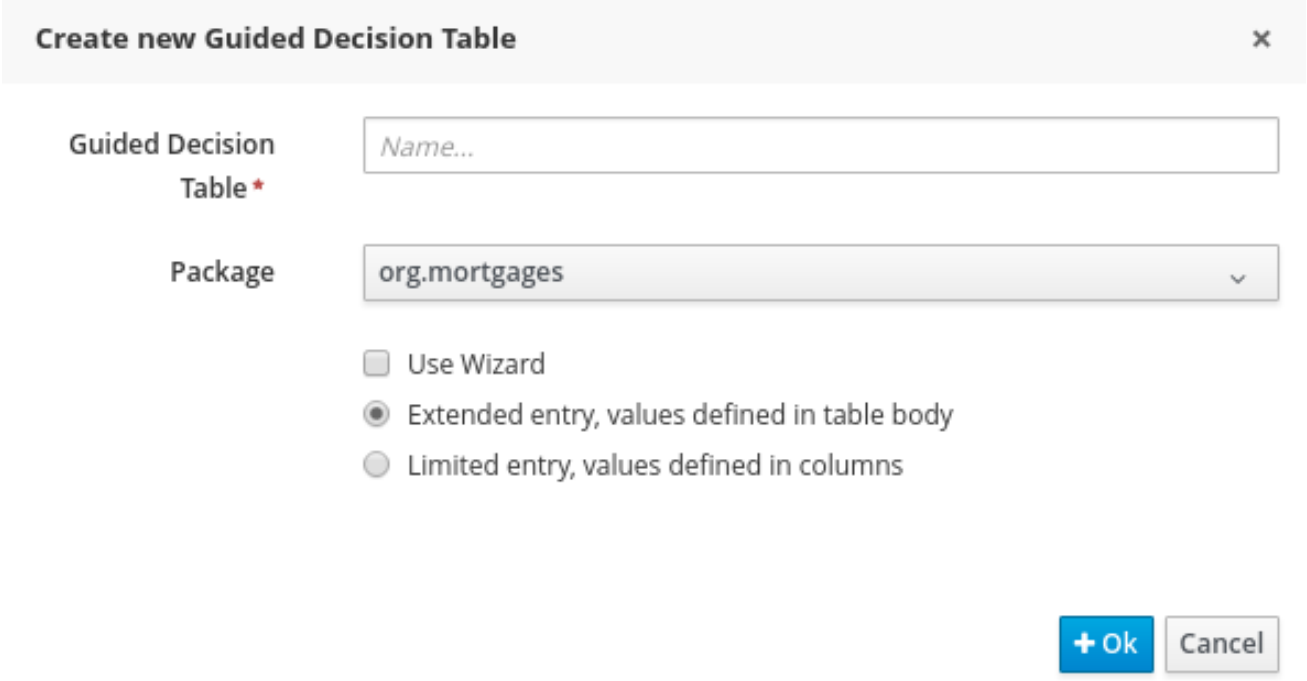
6.4. WEB BASED GUIDED DECISION TABLES

6.4.1. Web Based Guided Decision Tables

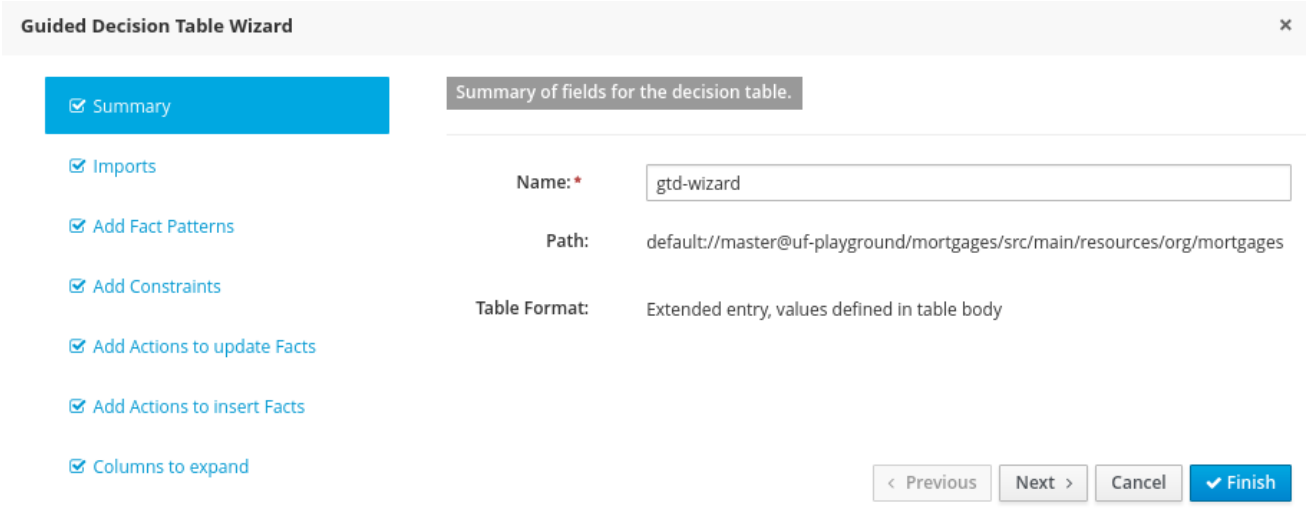
The (web based) Guided Decision Table feature works similar to the Guided Editor by introspecting what facts and fields are available to guide the creation of a decision table.

Rule attributes, meta-data, conditions and actions can be defined in a tabular format thus facilitating rapid entry of large sets of related rules. Web based decision table rules are compiled into DRL like all other rule assets.

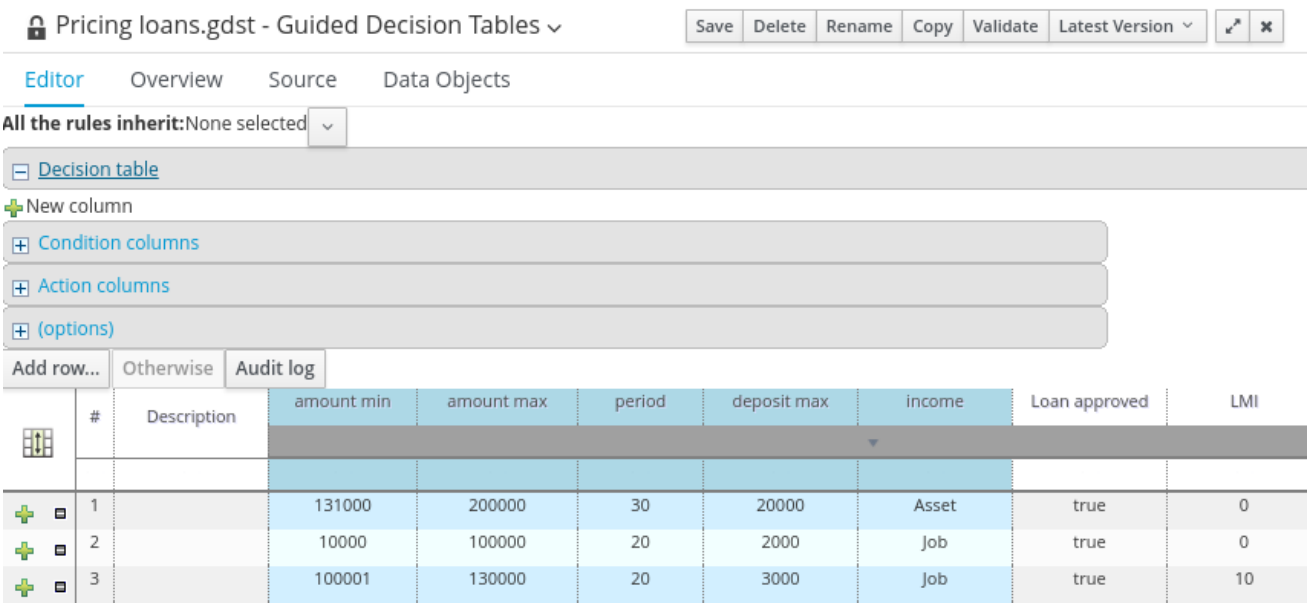
To create a new decision table, click on **New Item → Guided Decision Table**. Enter the name of the table and select whether you want the extended entry or limited entry table (Section 6.4.2, “Types of decision tables”). Optionally select to use the Guided Decision Table Wizard.



Click **OK** when done. If you didn't select the wizard, you will be presented with the editor for Guided Decision Tables. If you selected the wizard, you will be presented with the first screen of the wizard.



The wizard helps you define your imports, facts, patterns and columns, but not the rows. Rows are added in the Guided Decision Table Editor, which is what you are presented with at the end of the wizard (or directly if you didn't use the wizard).



When you build your own application comprising guided decision tables, ensure that you have the necessary dependencies added to your class path. For more information on dependencies for guided decision tables, see the *Dependency Management for Guided Decision Tables, Scorecards, and Rule Templates* section of the *Red Hat JBoss BRMS Development Guide*.

6.4.2. Types of decision tables

There are broadly two types of decision tables, both of which are supported:

- Extended Entry
- Limited Entry

Extended entry

An Extended Entry decision table is one for which the column definitions specify Pattern, Field and operator but not value. The values, or states, are themselves held in the body of the decision table. It is normal, but not essential, for the range of possible values to be restricted by limiting entry to values from a list. Business central supports use of Java enumerations or decision table "optional value lists" to restrict value entry.

Limited entry

A Limited Entry decision table is one for which the column definitions specify value in addition to Pattern, Field and operator. The decision table states, held in the body of the table, are boolean where a positive value (a checked tick-box) has the effect of meaning the column should apply, or be matched. A negative value (a cleared tick-box) means the column does not apply.

6.4.3. Column Configuration

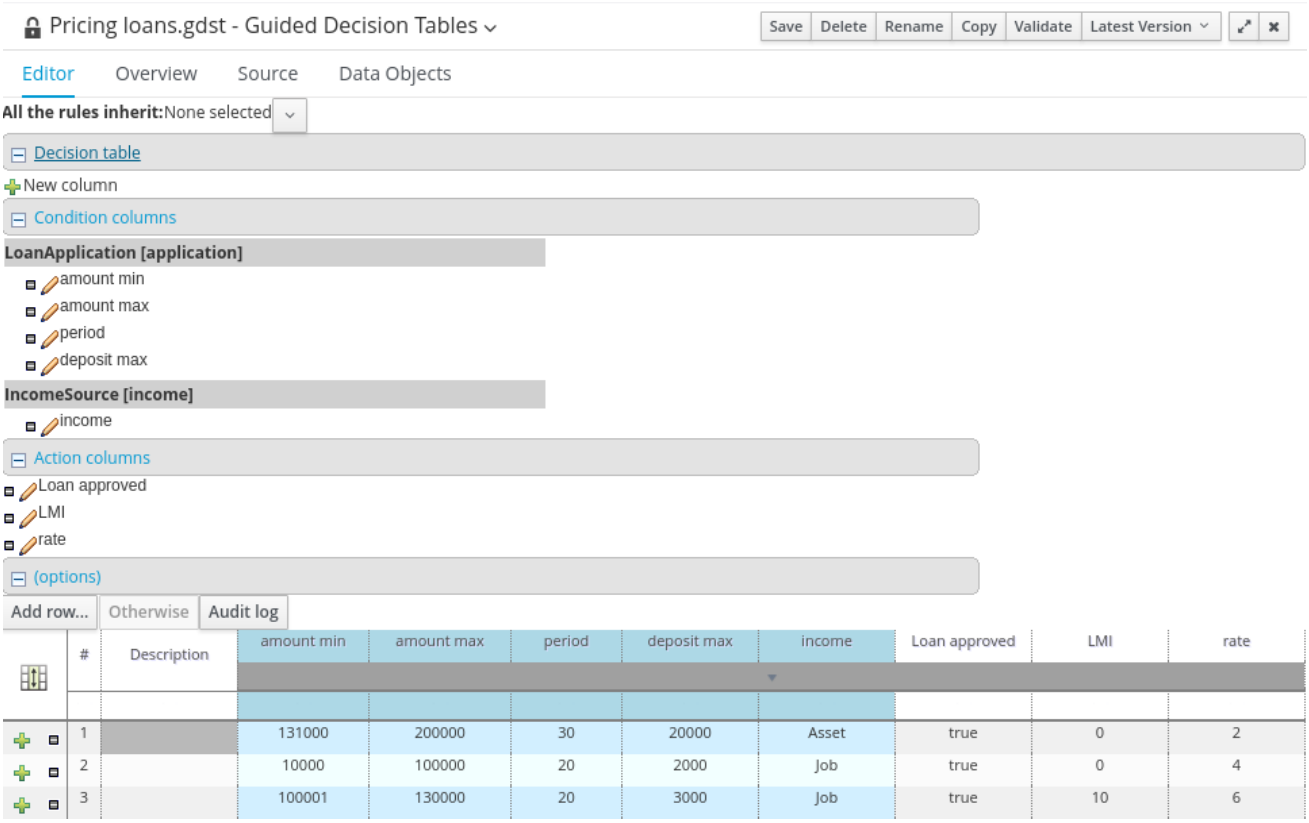
Columns can have the following types of constraint:

- Literal
  The value in the cell will be compared with the field using the operator.
- Formula
  The expression in the cell will be evaluated and then compared with the field.

- Predicate
  No field is needed, the expression will be evaluated to true or false.

You can set a default value, but normally if there is no value in the cell, that constraint will not apply.

Figure 6.6. Column Configuration



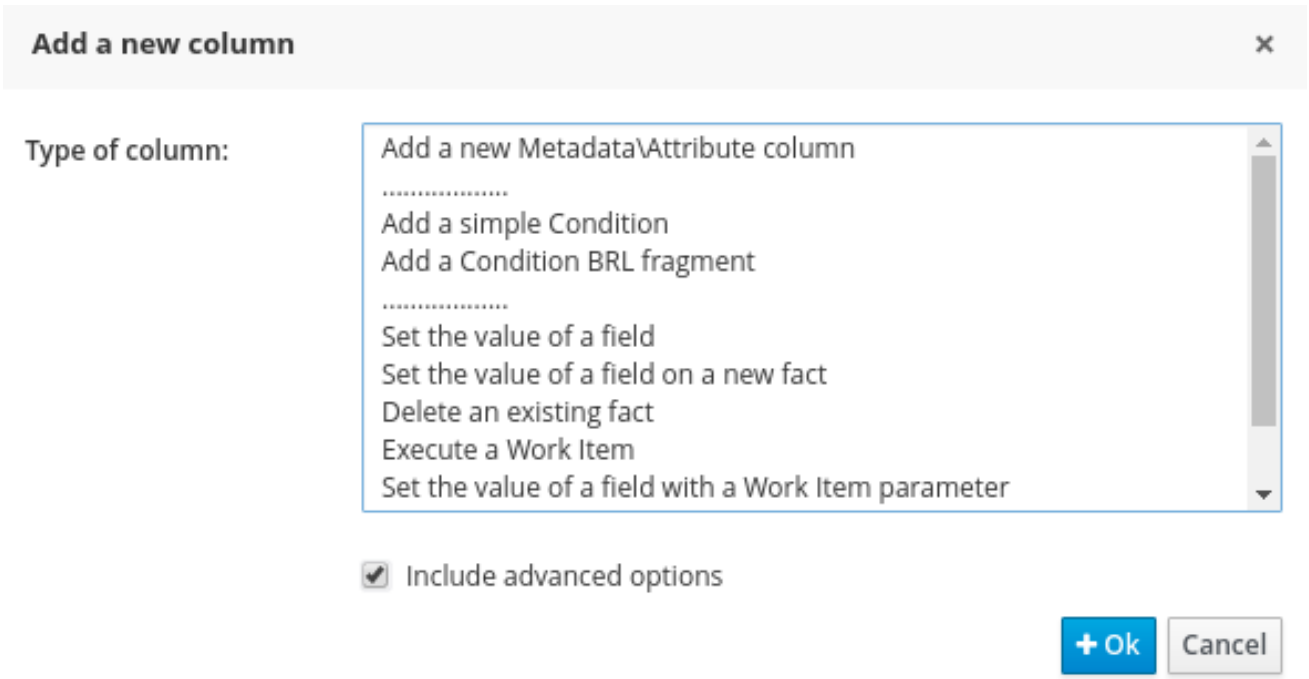
6.4.4. Adding Columns

To add a column within the Guided Decision Table Editor, click on the 

icon.

The following column type selection dialog appears:

Figure 6.7. Advanced Column Options



By default, the column type dialog shows the following types:

- Add a new Metadata\Attribute column
- Add a simple Condition
- Set the value of a field
- Set the value of a field on a new fact
- Delete an existing fact

Clicking on "Include advanced options" adds the following options:

- Add a Condition BRL fragment
- Execute a Work Item
- Set the value of a field with a Work Item parameter
- Set the value of a field on a new Fact with a Work Item parameter
- Add an Action BRL fragment

6.4.5. Column Types

6.4.5.1. Attribute Columns

Zero or more attribute columns representing any of the DRL rule attributes can be added. An additional pseudo attribute is provided in the guided decision table editor to "negate" a rule. Use of this attribute allows complete rules to be negated. For example, the following simple rule can be negated as also shown.

```
when
```

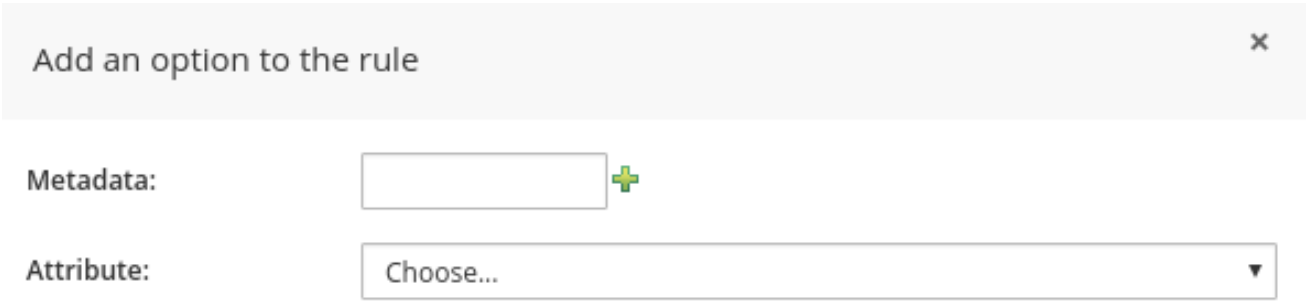
```
  $c : Cheese( name == "Cheddar" )
then
  ...
end
```

```
when
  not Cheese( name == "Cheddar" )
then
  ...
end
```

6.4.5.2. Metadata Columns

Zero or more meta-data columns can be defined, each represents the normal meta-data annotation on DRL rules. To add Metadata, click **New column** and select **Add a new Metadata\Attribute column**.

Figure 6.8. Attribute and MetaData Option



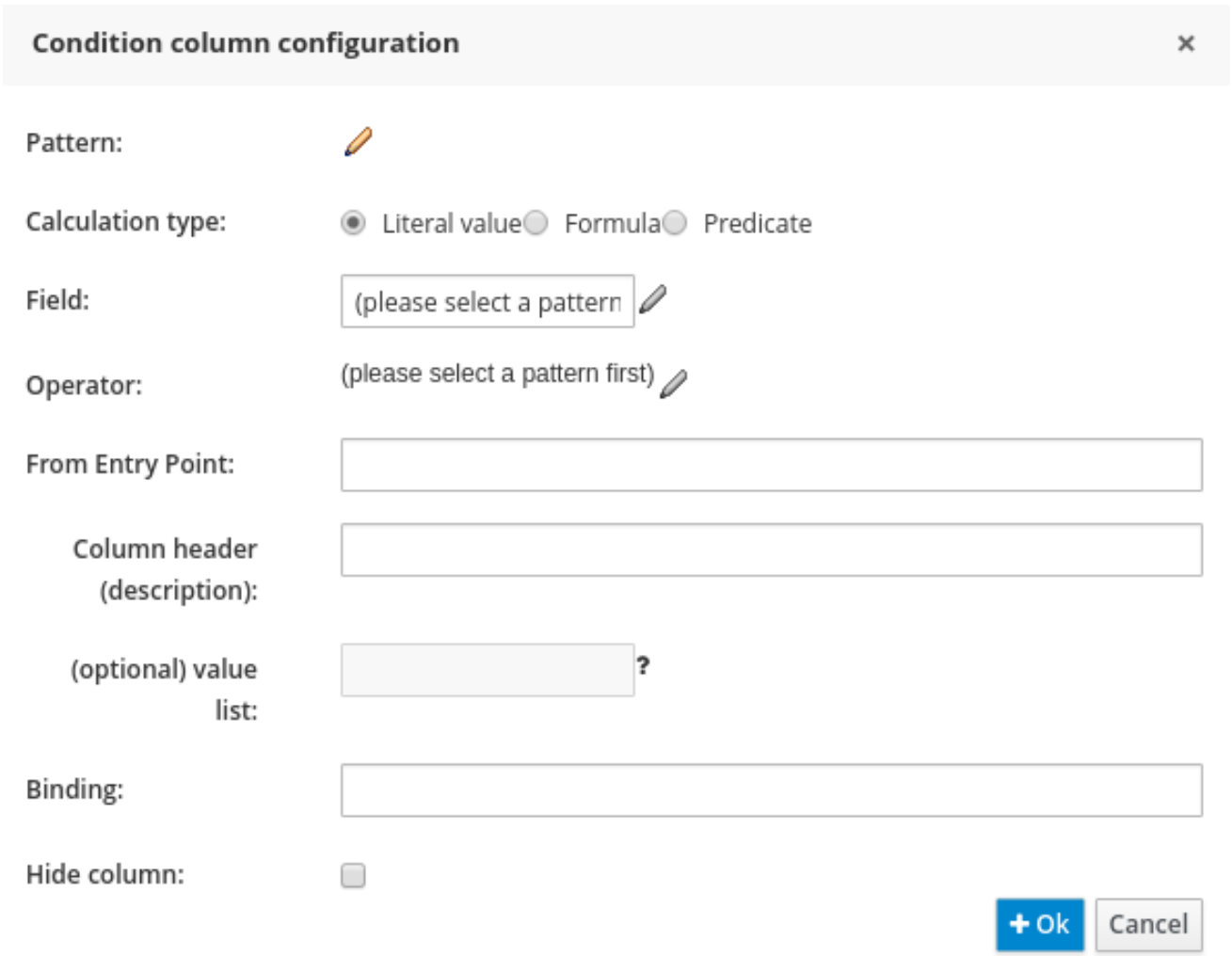
6.4.5.3. Condition Columns

Conditions represent fact patterns defined in the right-hand side, or "when" portion, of a rule. To define a condition column, you must define a binding to a model class or select one that has previously been defined. You can choose to negate the pattern. Once this has been completed, you can define field constraints. If two or more columns are defined using the same fact pattern binding, the field constraints become composite field constraints on the same pattern. If you define multiple bindings for a single model class, each binding becomes a separate model class in the right-hand side of the rule.

When you edit or create a new column, you will be given a choice of the type of constraint:

- Literal: The value in the cell will be compared with the field using the operator.
- Formula: The expression in the cell will be evaluated and then compared with the field.
- Predicate: No field is needed, the expression will be evaluated to true or false.

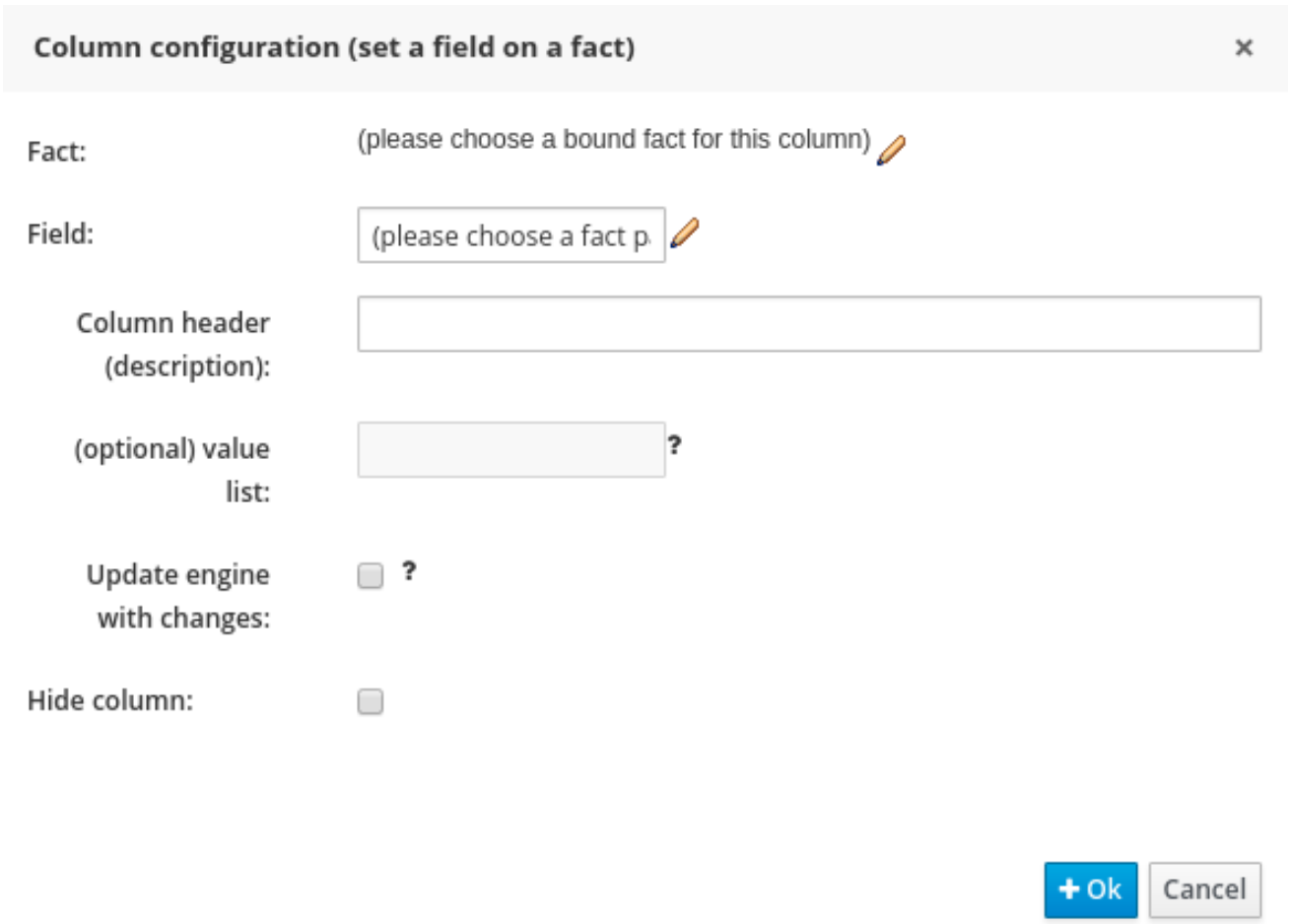
Figure 6.9. Simple Condition Column



6.4.5.4. Field Value Columns

Creates an Action to set the value of a field on a previously bound fact. You have the option to notify the Rule Engine of the modified values which could lead to other rules being re-activated.

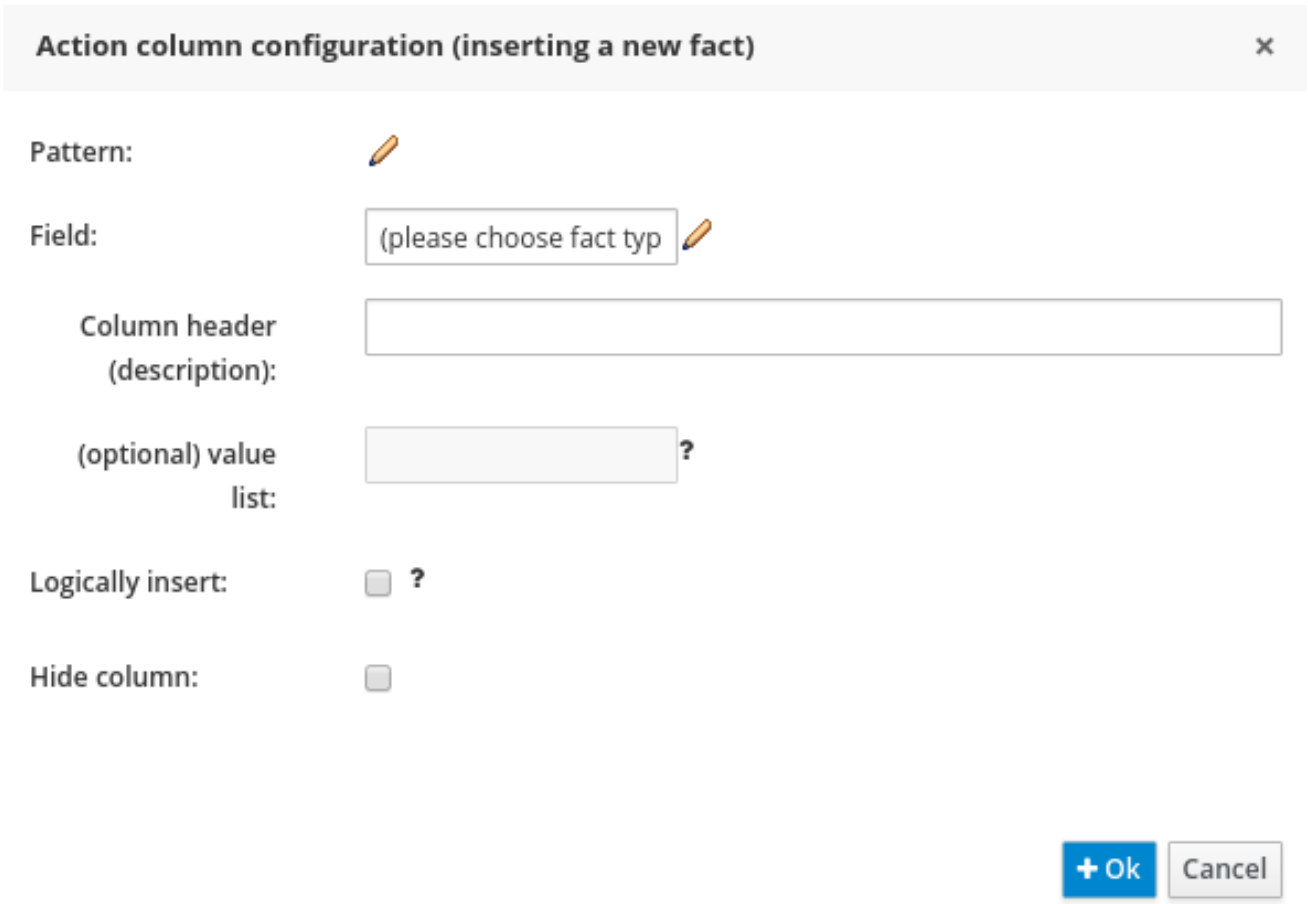
Figure 6.10. Set the value of a field



6.4.5.5. New Fact Field Value Columns

This column allows an Action to insert a new Fact into the Rule Engine Working Memory, and it sets the value of one of the new Facts' fields. You can choose to have the new Fact "logically inserted;" that is, it will automatically be deleted should the conditions leading to the action being invoked cease to be true. See the *Red Hat JBoss Development Guide* for information about truth maintenance and logical insertions.

Figure 6.11. Set the value of a field on a new fact



6.4.5.6. Delete Existing Fact Columns

The implementation of an Action to delete a bound Fact.

Figure 6.12. Delete an existing fact

6.4.6. Advanced Column Types

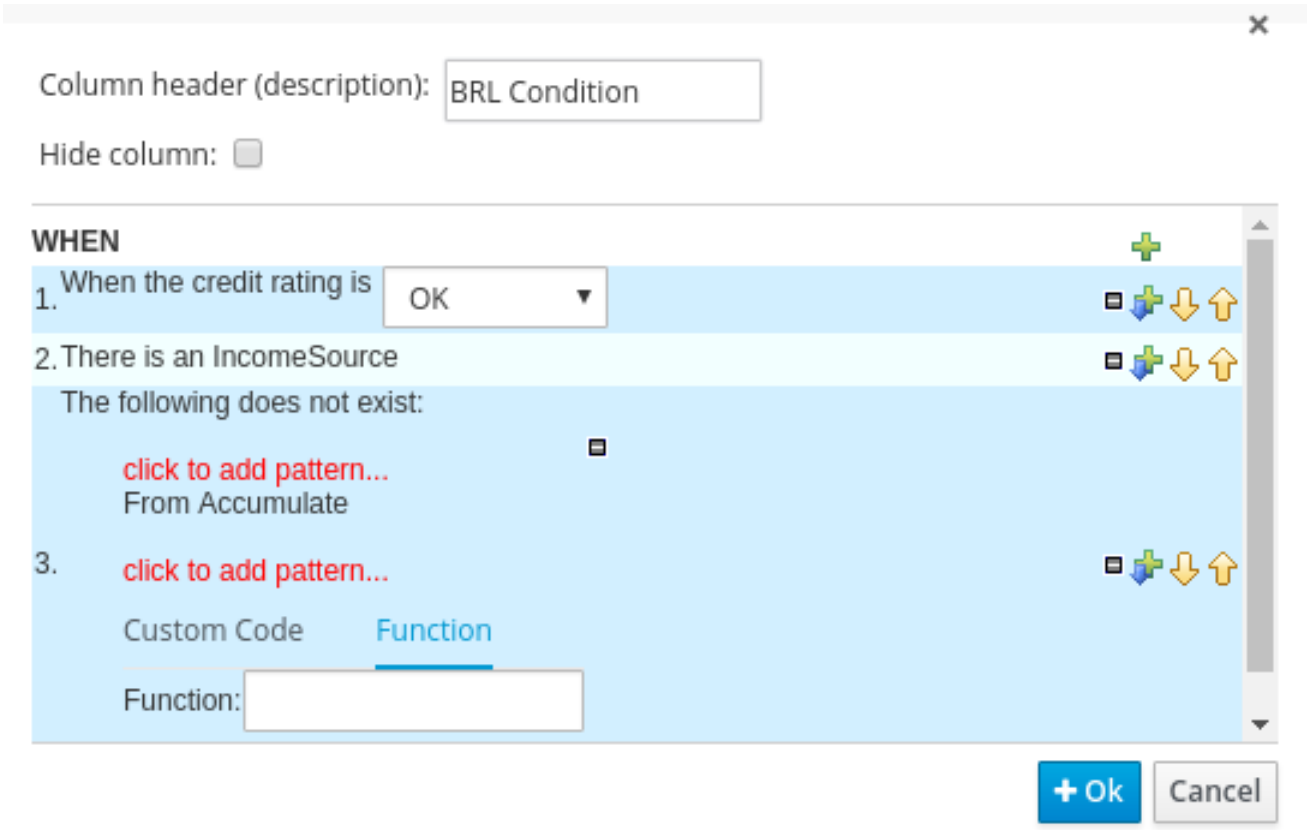
6.4.6.1. Condition BRL Fragment Columns

A construct that allows a BRL fragment to be used in the left-hand side of a rule. A BRL

fragment is authored using the Guided Rule Editor and hence all features available in that editor can be used to define a decision table column such as the following: "from", "collect", and "accumulate". When using the embedded Guided Rule Editor, field values defined as "Template Keys" will form columns in the decision table. Facts and Fact's fields bound in the BRL fragment can be referenced by the simpler column types and vice-versa.

The following example displays a BRL Condition for a shopping tier.

Figure 6.13. Add a Condition BRL fragment



6.4.6.2. Execute Work Item Columns

This implements an Action to invoke a Red Hat JBoss Business Process Management Suite Work Item Handler. It sets its input parameters to bound Facts/Facts' fields values. This works for any Work Item Definition.

Figure 6.14. Execute a Work Item

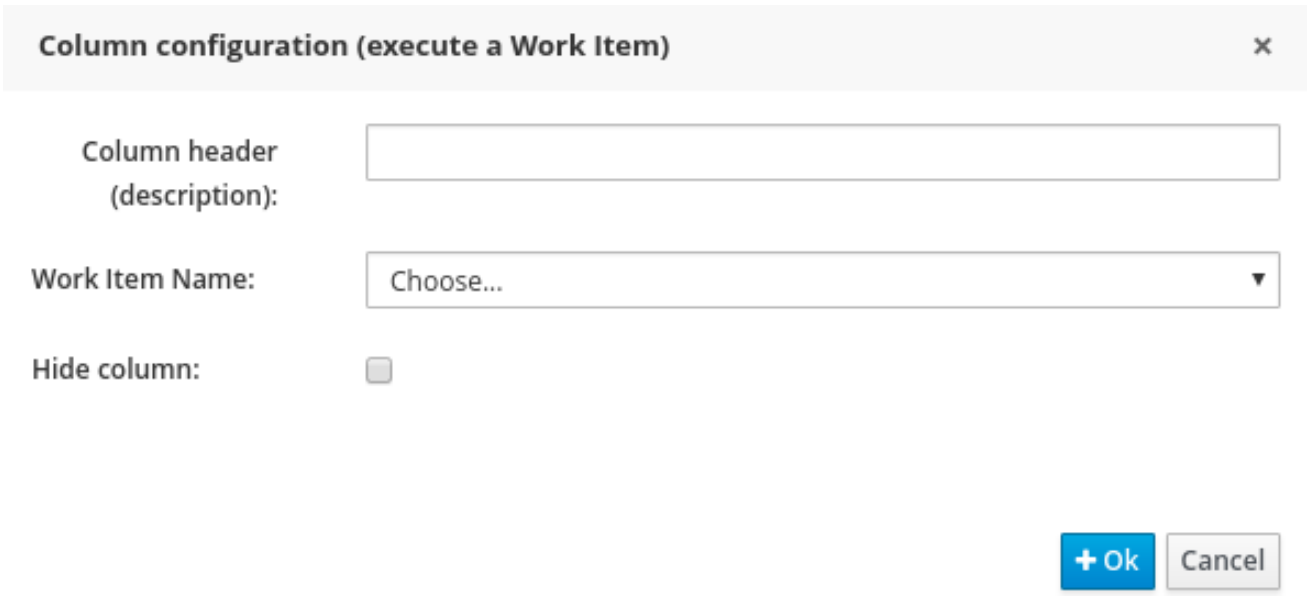


Figure 6.15. WS Work Item

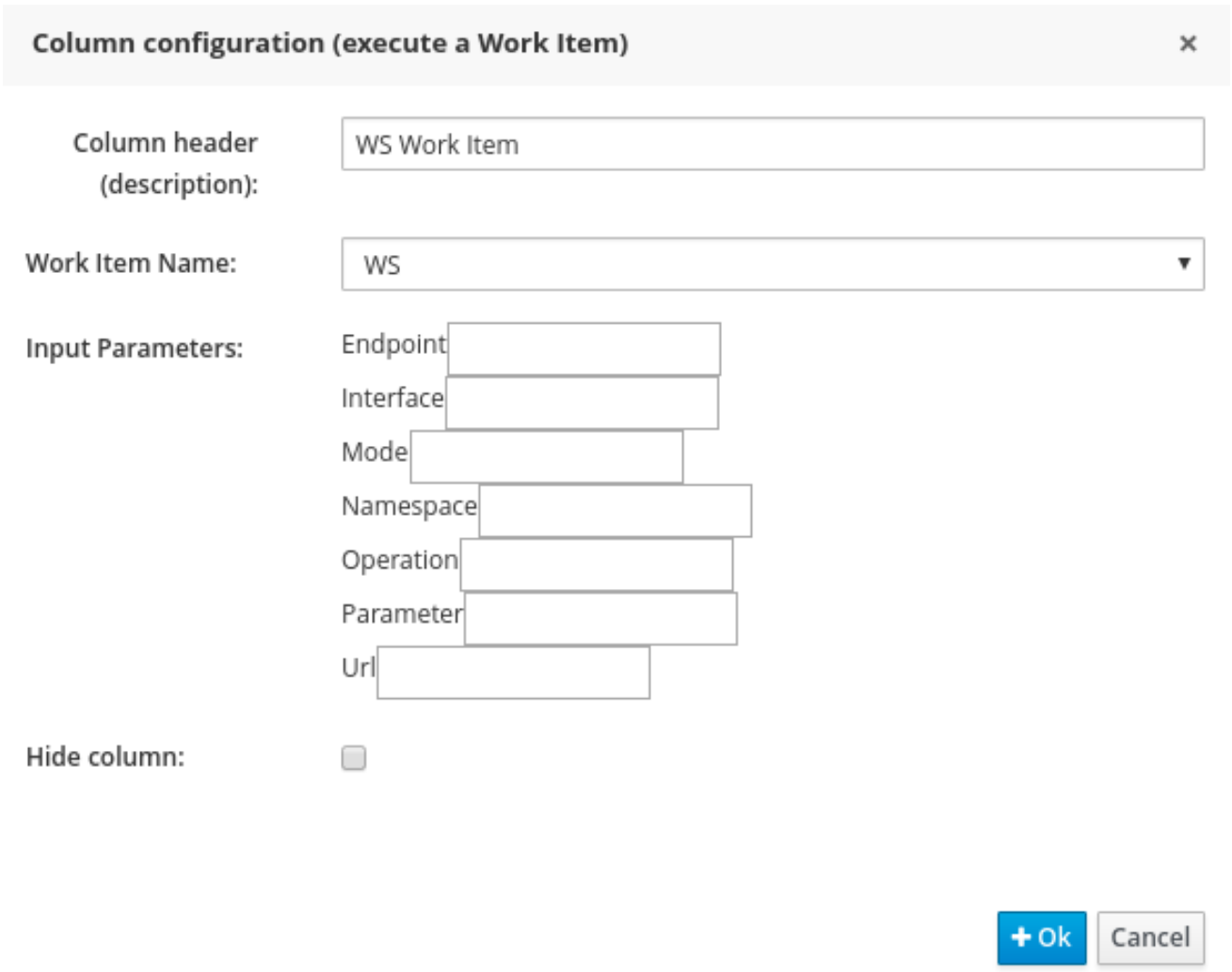


Figure 6.16. REST Work Item

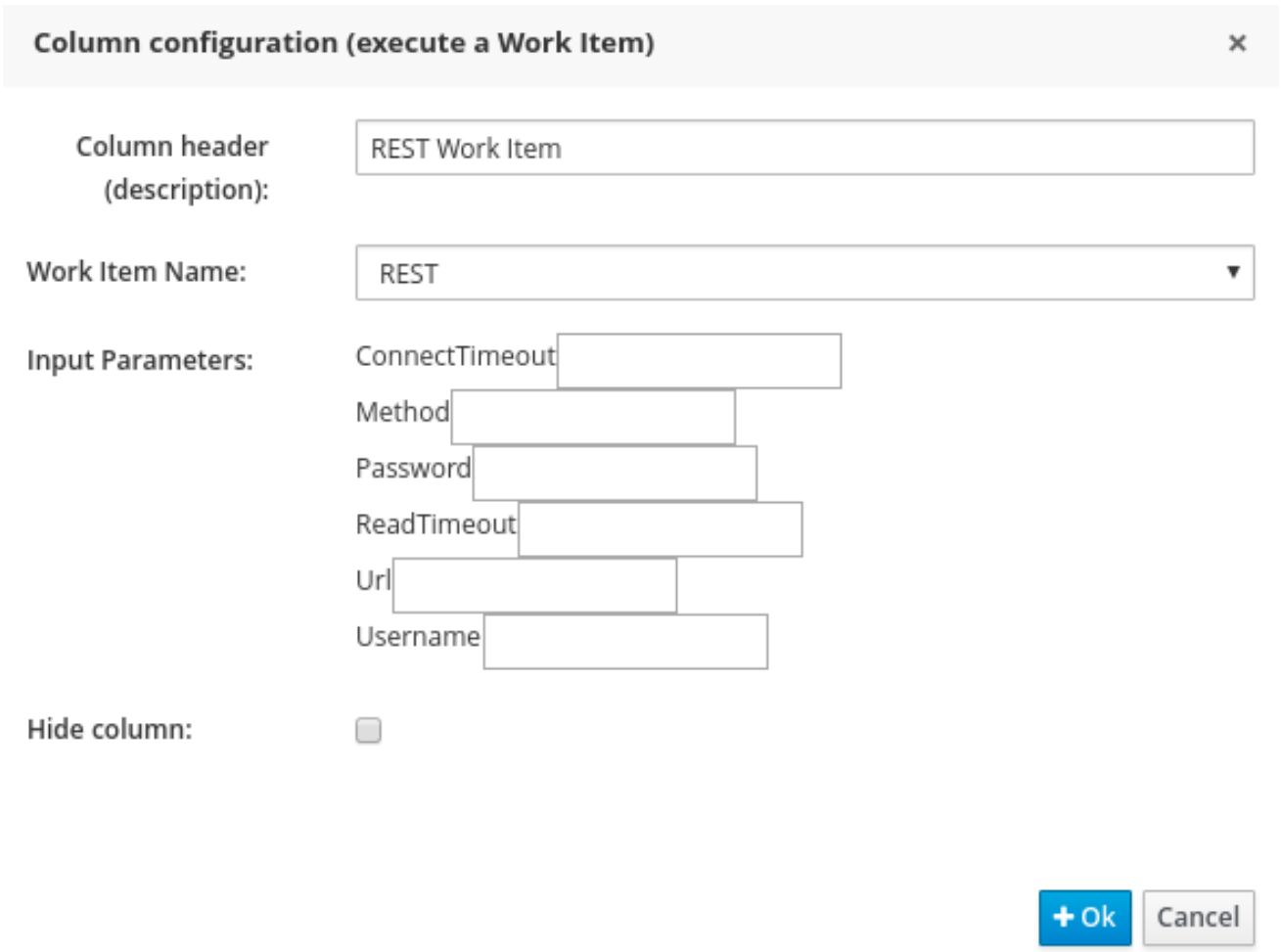


Figure 6.17. Log Work Item

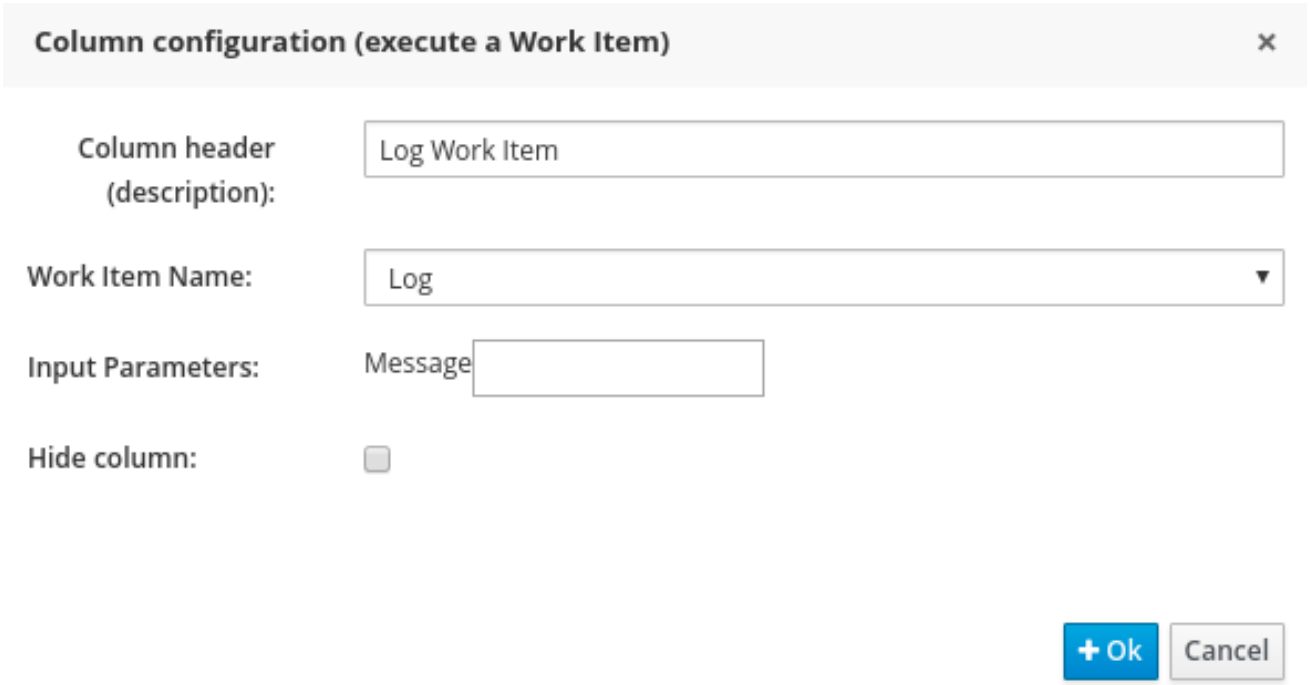
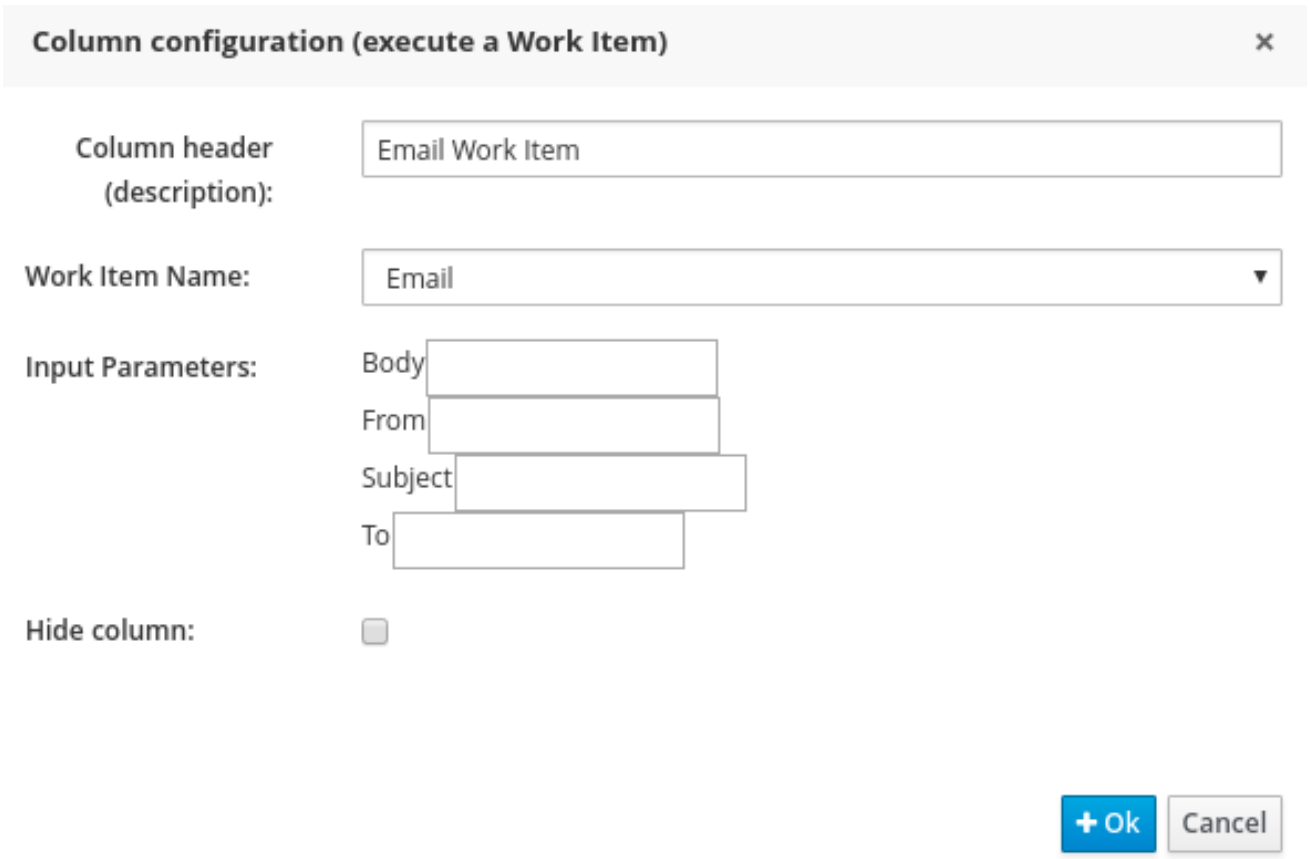


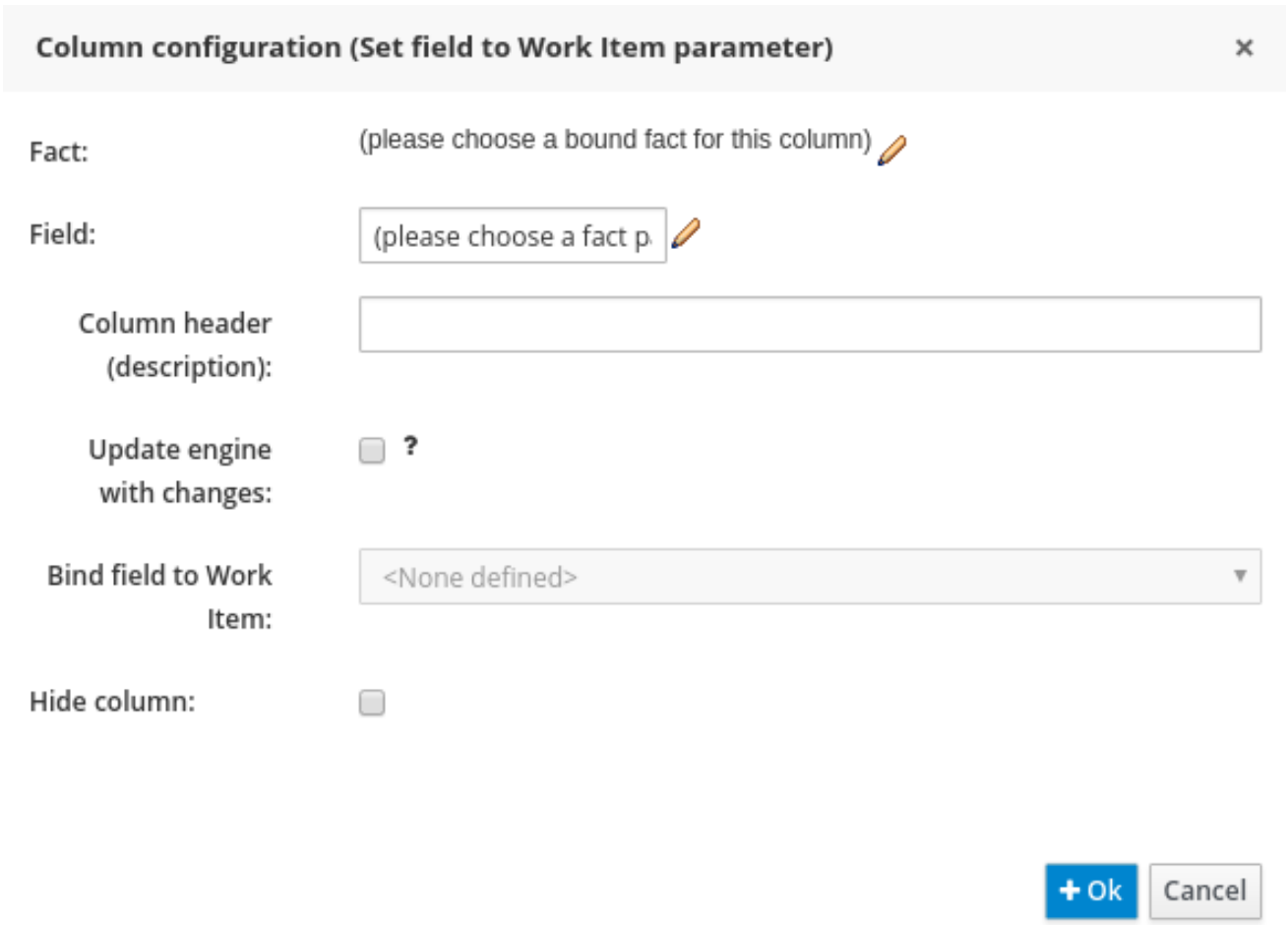
Figure 6.18. Email Work Item

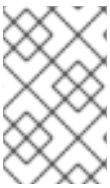


6.4.6.3. Field Value with Work Item Parameter Columns

This implements an Action to set the value of a Fact's field to that of a Red Hat JBoss Business Process Management Suite Work Item Handler's result parameter. The Work Item needs to define a result parameter of the same data-type as a field on a bound fact; this will allow you to set the field to the return parameter.

Figure 6.19. Set the value of a field with a Work Item parameter





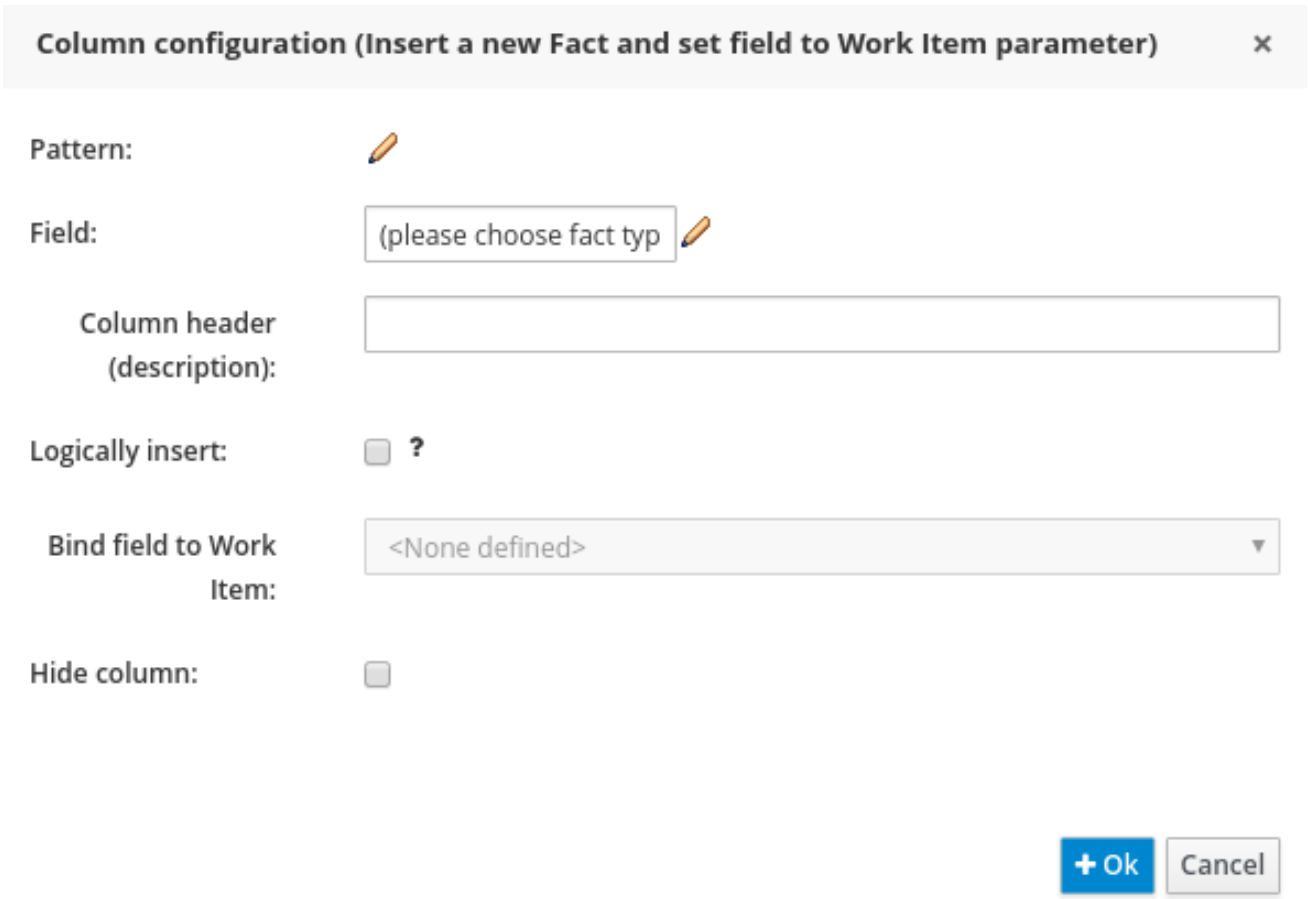
NOTE

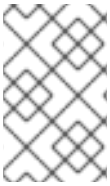
Please note that in order to set the "Bind field to Work Item" option, you first need to have an Action executing a Work Item. This will allow you to set the field of an existing Fact based on a Work Item's results.

6.4.6.4. New Fact Field Value with Work Item Parameter Columns

This implements an Action to set the value of a new Fact's field to that of a Red Hat JBoss Business Process Management Suite Work Item Handler's result parameter. Again, this Work Item needs to define a result parameter of the same data-type as a field on a bound fact type. You should then be able to set the field to the return parameter.

Figure 6.20. Set the value of a field on a new Fact with a Work Item parameter.





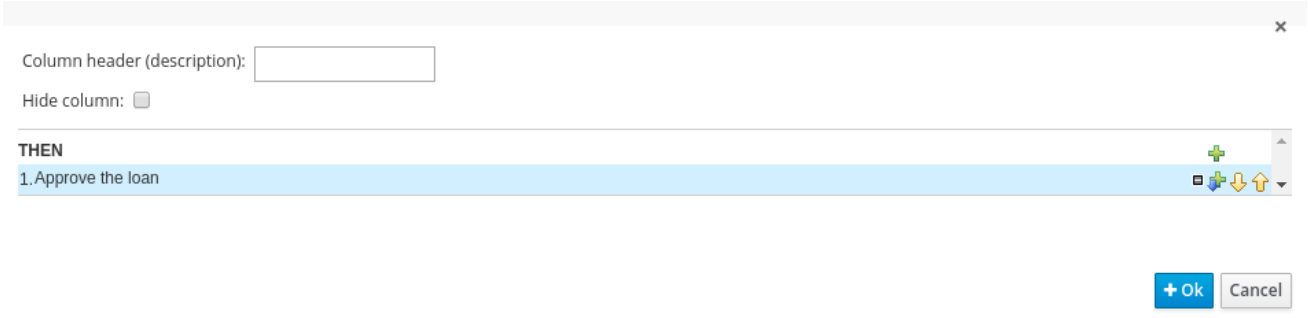
NOTE

Please note that in order to set the "Bind field to Work Item" option, you first need to have an Action executing a Work Item. This will allow you to insert a new Fact with a field value from a Work Item's Results.

6.4.6.5. Action BRL Fragment Columns

A construct that allows a BRL fragment to be used in the right-hand side of a rule. A BRL fragment is authored using the Guided Rule Editor and hence all features available in that editor can be used to define a decision table column. When using the embedded Guided Rule Editor, field values defined as "Template Keys" will form columns in the decision table. Facts bound in the BRL fragment can be referenced by the simpler column types and vice-versa.

Figure 6.21. Simple layout for Adding an Action BRL fragment

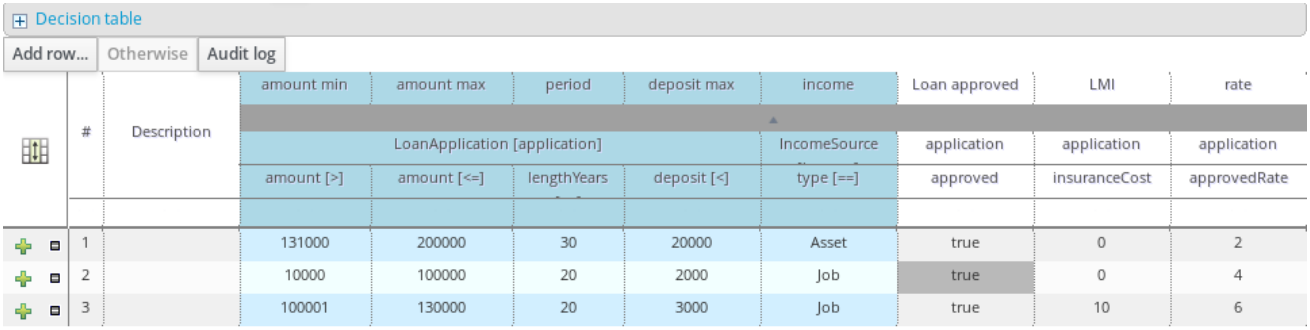


6.4.7. Rule Definition

Rules are created in the main body of the decision table using the columns that have already been defined.

Rows of rules can be added or deleted by clicking the plus or minus symbols respectively.

Figure 6.22. Rule Definition



#	Description	amount min	amount max	period	deposit max	income	Loan approved	LMI	rate
		LoanApplication [application]				IncomeSource	application	application	application
		amount [>]	amount [<=]	lengthYears	deposit [<]	type [==]	approved	insuranceCost	approvedRate
1		131000	200000	30	20000	Asset	true	0	2
2		10000	100000	20	2000	Job	true	0	4
3		100001	130000	20	3000	Job	true	10	6

6.4.8. Cell Merging

The icon in the top left of the decision table toggles cell merging on and off. When cells are merged, those in the same column with identical values are merged into a single cell. This simplifies changing the value of multiple cells that shared the same original value. When cells are merged, they also gain an icon in the top-left of the cell that allows rows spanning the merged cell to be grouped.

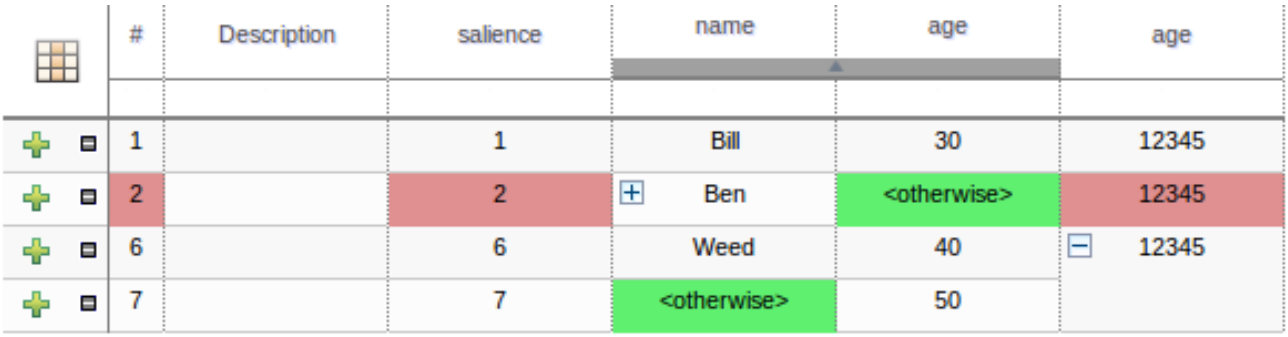
Figure 6.23. Cell Merging

#	Description	salience	name	age	age
1		1	Bill	30	12345
2		2	Ben	<otherwise>	
3		3			
4		4			
5		5			
6		6	Weed	40	12345
7		7	<otherwise>	50	

6.4.9. Cell Grouping

Cells that have been merged can be further collapsed into a single row. Clicking the [+\-] icon in the top left of a merged cell collapses the corresponding rows into a single entry. Cells in other columns spanning the collapsed rows that have identical values are shown unchanged. Cells in other columns spanning the collapsed rows that have different values are highlighted and the first value displayed.

Figure 6.24. Cell Grouping



When the value of a grouped cell is altered, all cells that have been collapsed also have their values updated.

6.4.10. Otherwise Operations

Condition columns defined with literal values that use either the equality **==** or inequality **!=** operators can take advantage of a special decision table cell value of **`otherwise`**. This special value allows a rule to be defined that matches on all values not explicitly defined in all other rules defined in the table. This is best illustrated with an example:

```
when
  Cheese( name not in ("Cheddar", "Edam", "Brie") )
  ...
then
  ...
end
```

```
when
  Cheese( name in ("Cheddar", "Edam", "Brie") )
  ...
then
  ...
end
```

6.5. RULE TEMPLATES

6.5.1. The Guided Rule Template

Rule Templates allow the user to define a rule structure. They provide a place-holder for values and data, and they populate templates to generate many rules. From the user's perspective, Guided Rule Templates are a parametrized guided rule with a data table which provides parameter values. This can allow for more flexible decision tables and it can enhance the flexibility of rules in existing databases. For information on managing dependencies of Rule Templates, see the *Dependency Management for Guided Decision Tables, Scorecards, and Rule Templates* section of the *Red Hat JBoss BRMS Development Guide*.

Procedure: Creating a new Guided Rule Template

1. In the **Project Explorer** view, do one of the following:
    a. If you are in the Project view, select the organizational unit, repository, and the

project where you want to create the template.

b. If you are in the Repository view, navigate to **`src/main/resources/`** and the **`SUBFOLDER/PACKAGE`** where you want to create the project folder for the rule template.

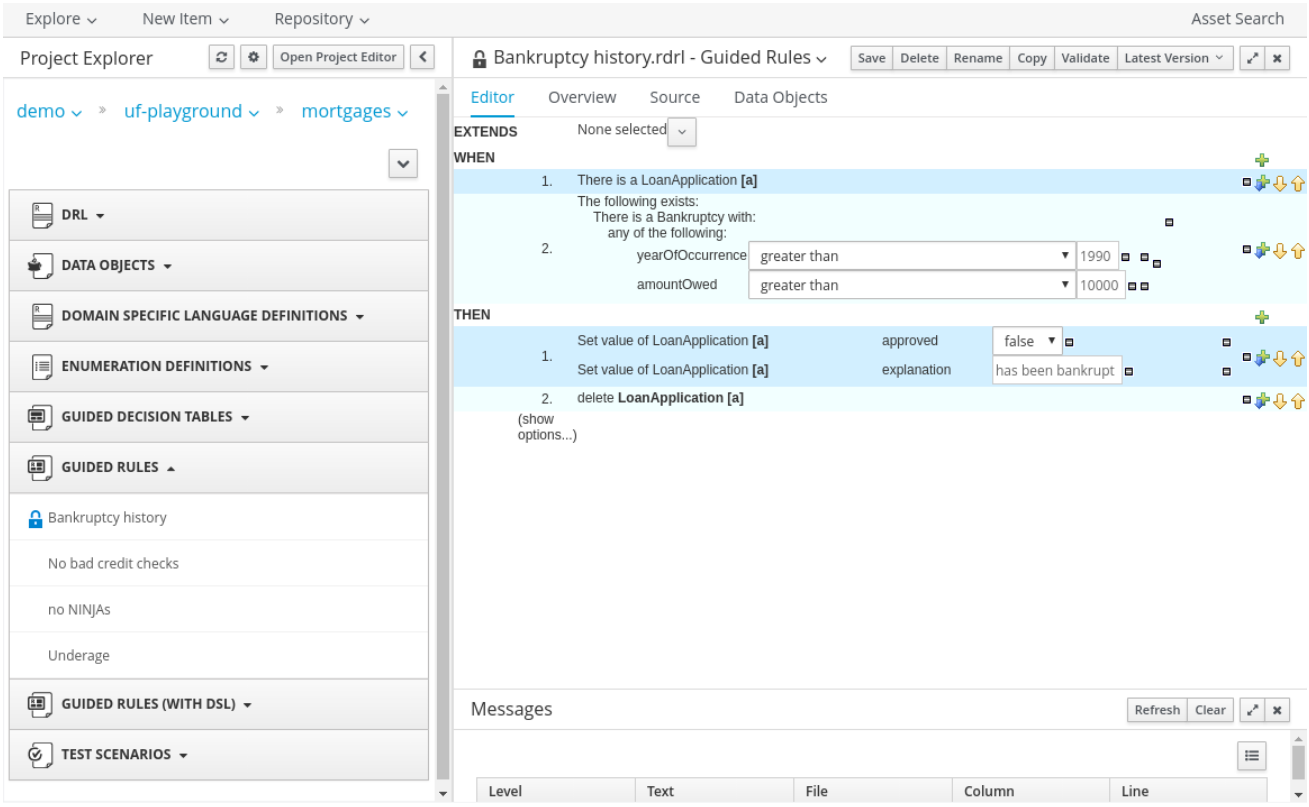
2. In the perspective menu, go to **New Item** → **Guided Rule Template**.

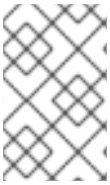
3. In the **Create new Guided Rule Template** dialog window, specify the rule template name:

   a. In the **Resource Name** text box, enter the Guided Rule Template name and click **OK**.

4. The new Guided Rule Template is now created and under the selected project.

Figure 6.25. Guided Template Editor





NOTE

Using a plain rule template and manipulating rules and spreadsheets directly from Business Central is not supported by Red Hat. It is recommended that you create and use Guided Rule Template using Business Central.

6.5.2. WHEN conditions in the Guided Rule Template

The **`Guided Template Editor`** in Business Central allows users to set rule templates where the data is kept separate from the rules.

NOTE

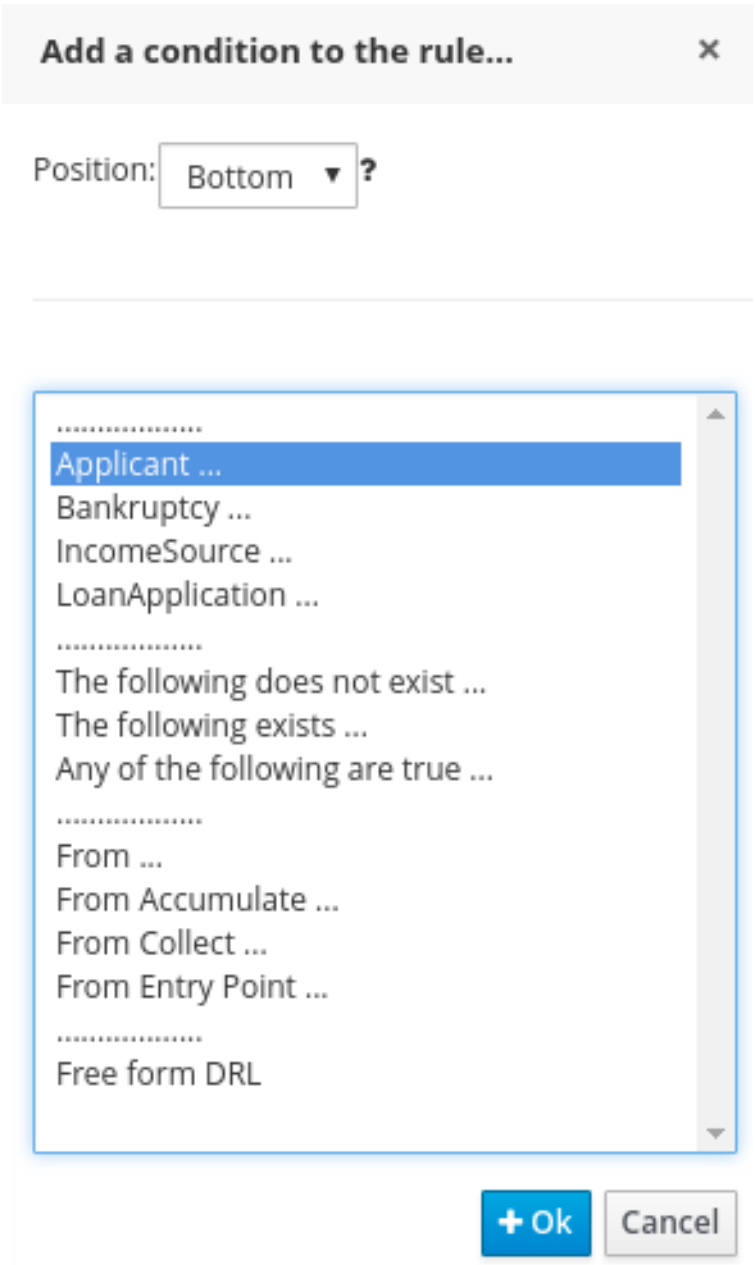
In the Guided Rule Template example procedures below, a Nurse Rostering data model was created for a fictitious hospital, Sister Veronica's.

Procedure: Using the Guided Template Editor with WHEN Constraints

1. Assuming you have already set up a Data Model for your project (as described in Section 5.3, “Creating Data Object (Not Persistable)”), select the plus icon to the right of the **WHEN** section of the Guided Template Editor.

2. A dialog window will appear with available condition templates to choose from. In the example below, we select the **Applicant...** condition from the list.

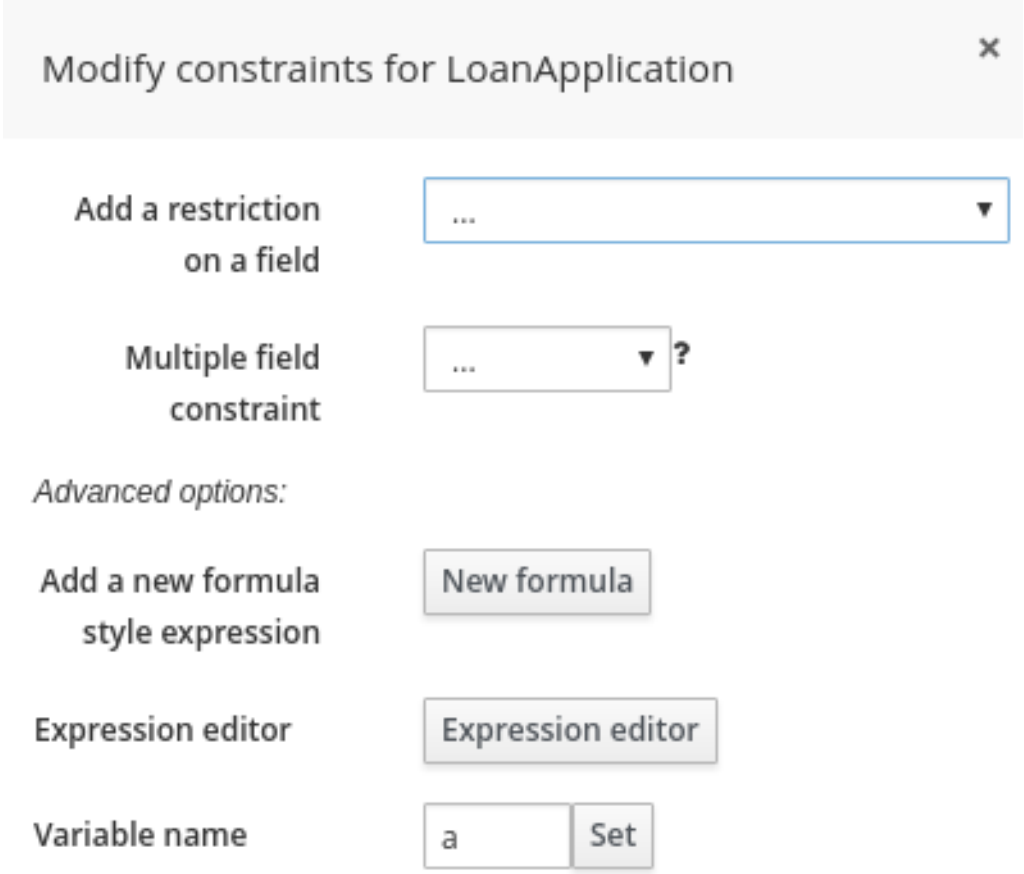
   Figure 6.26. Nurse Roster WHEN Dialog Window



3. Click **OK** and the Guided Template Editor will display your **WHEN** condition.

4. Click on the newly added **WHEN** condition. In the example below, it is the "There is a Loan" condition. A "Modify constraints for LoanApplication" dialog appears.

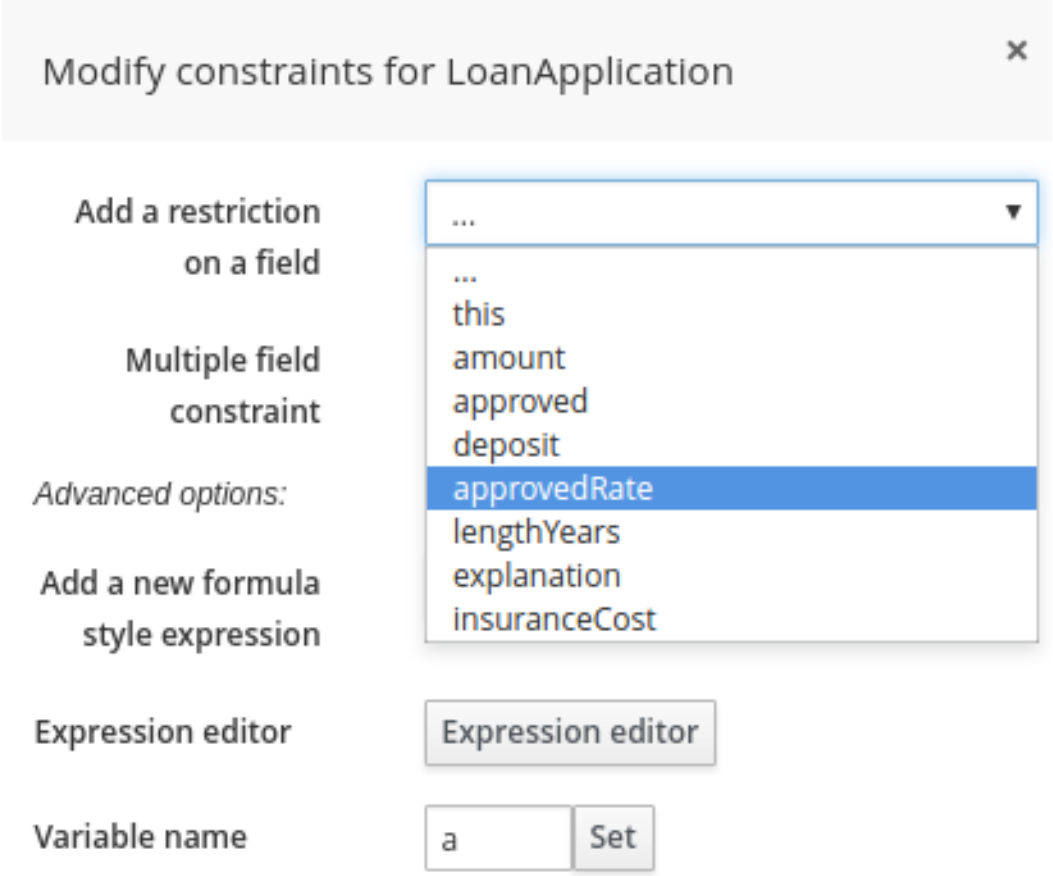
Figure 6.27. Modify Constraints Dialog



5. From here you can add a restriction on a field, apply multiple field constraints, add a new formula style expression, apply an expression editor, or set a variable name.

6. In the example below, we will add a restriction of **`approvedRate`** to the condition.

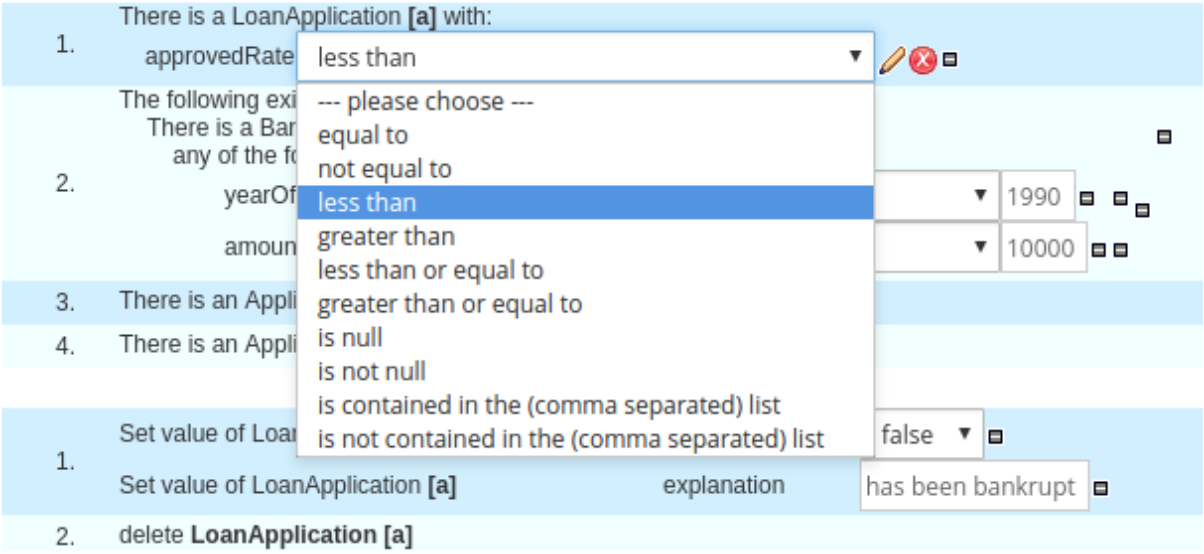
Figure 6.28. Adding a Restriction on a Field



7. Once selected, the dialog window closes automatically.

8. Next to the newly selected restriction will be a drop down box to choose an operator. In the example below, we have chosen an operator of "less than."

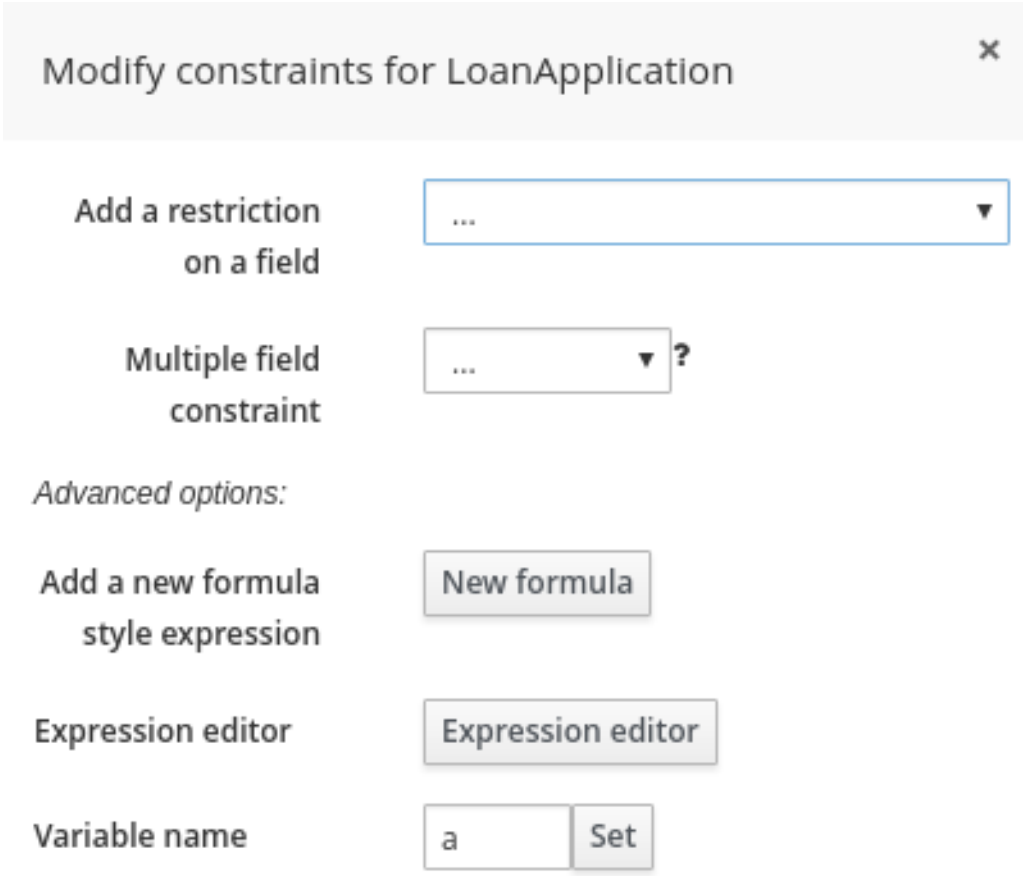
Figure 6.29. Restriction Drop-Down Menu



9. By selecting the **Edit Icon**  within the restrictions field, you will be able to define the field value with a literal value, template key, a formula, or expression editor.

10. By clicking on the **WHEN** condition again, we can supply a variable name to help define the restriction. In the example below, we name it "a" and click **Set**.

Figure 6.30. Setting a Variable Name



11. Continue to add **WHEN** conditions as appropriate for the project.

6.5.3. THEN Actions in the Guided Rule Template

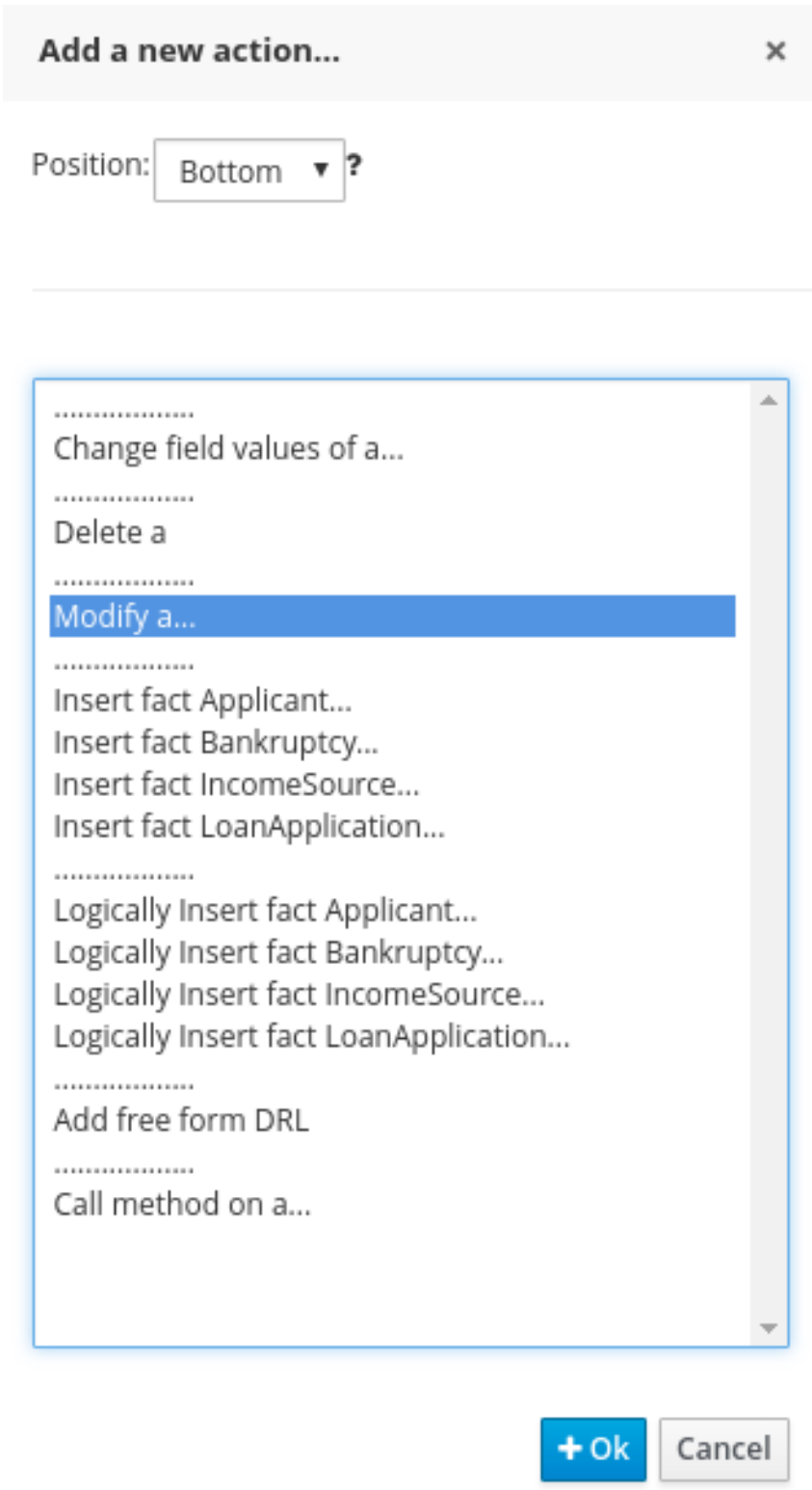
The **THEN** section of a rule holds the actions to be executed when it matches the **WHEN** section.

Procedure: Using the Guided Template Editor with THEN Actions

1. Select the plus icon to the right of the **THEN** section of the Guided Template Editor to input **THEN** actions.

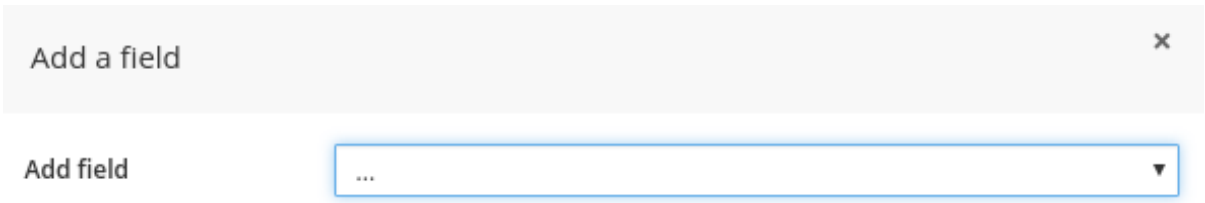
2. A dialog window will appear with available action templates to choose from. In the example below, we select the **Modify a...** action from the list.

Figure 6.31. Nurse Roster THEN Dialog Window



3. Click **OK** and the Guided Template Editor will display your**THEN** action.
4. Click on the newly added **THEN** action. In the example below, it is the **Modify value of LoanApplication [a]**"  action. An **Add a field** dialog appears.

Figure 6.32. Add a Field Dialog



5. Within this dialog, you can choose a field from the **Add field** drop-down menu.
6. Once selected, the dialog window closes automatically.
7. By selecting the **Edit Icon**  within the item field, you will be able to define the field value with a literal value, template key, or a formula.

6.5.4. Data Tables in the Guided Rule Template

Data tables can be altered within the Guided Template Editor directly by clicking on the **Data** tab. The procedure below illustrates how to alter the data created within Guided Template Editor itself.

Procedure: Using the Guided Template Editor with Data Tables

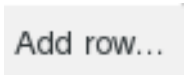
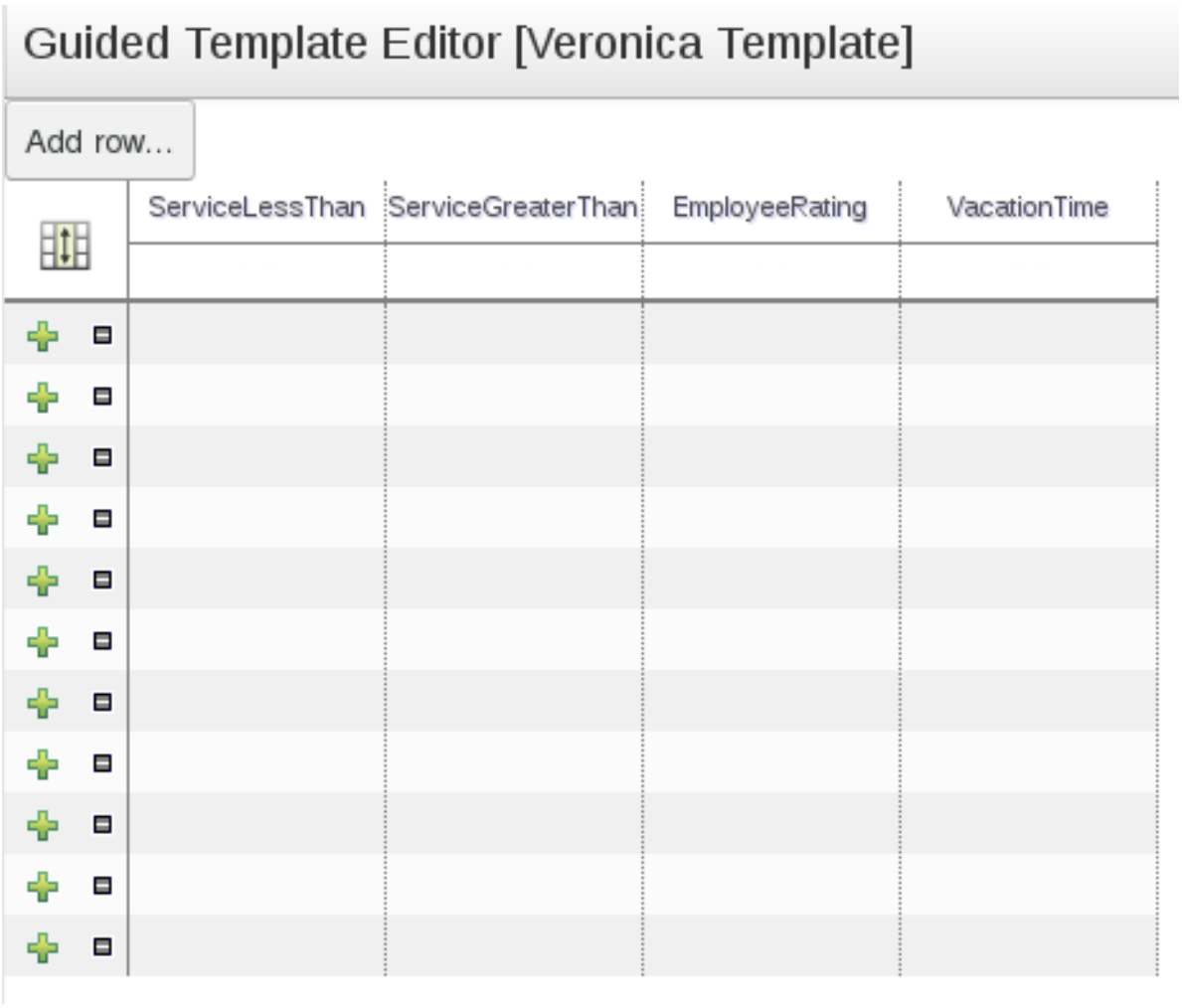
1. Click on the Data tab at the bottom of the Guided Template Editor in order to access the newly created data table.
2. Click the **Add row...**  button to add more table rows.
3. Input additional data into the table. In the example below, we see the ServiceLessThan, ServiceGreaterThan, EmployeeRating, and VacationTime column options and supply data to each field.

Figure 6.33. Data Table for Guided Template Editor



4. To view the code, click the **Source** tab at the top of the Guided Template Editor.

5. Save the template when you are finished working in the Guided Template Editor.

6.6. THE DOMAIN SPECIFIC LANGUAGE EDITOR

Sentence constructed from domain specific languages (or DSL sentences) can be edited in the DSL editor. See the *Red Hat JBoss BRMS Development Guide* for more information about domain specific languages. The DSL syntax is extended to provides hints to control how the DSL variables are rendered. The following hints are supported:

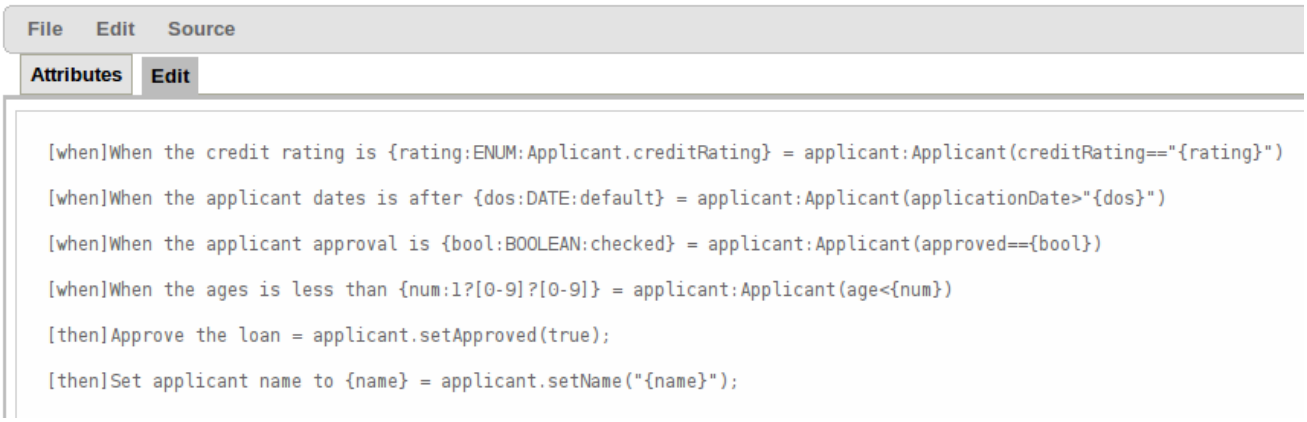
- {<varName>:<regular expression>}
  This will render a text field in place of the DSL variable when the DSL sentence is used in the guided editor. The content of the text field will be validated against the regular expression.

- {<varName>:ENUM:<factType.fieldName>}
  This will render an enumeration in place of the DSL variable when the DSL sentence is used in the guided editor. <factType.fieldName> binds the enumeration to the model fact and field enumeration definition. This could be either a Knowledge Base enumeration or a Java enumeration, i.e., defined in a model POJO JAR file.

- {<varName>:DATE:<dateFormat>}
  This will render a date selector in place of the DSL variable when the DSL sentence is used in the guided editor.

- {<varName>:BOOLEAN:<[checked | unchecked]>}
  This will render a dropdown selector in place of the DSL variable, providing boolean choices, when the DSL sentence is used in the guided editor.

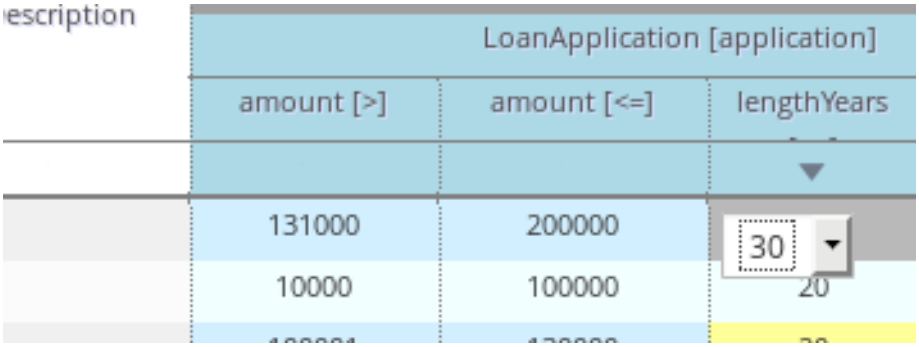
Figure 6.34. DSL Editor



6.7. DATA ENUMERATIONS

6.7.1. Data Enumerations Drop-Down List Configuration

Data enumerations are an optional type of asset that can be configured to provide drop-down lists for the Guided Decision Table Editor. Double-click on a cell to view the enumeration drop-down list if the cell condition is based the same fact and field as the enumeration.



They are stored and edited just like any other asset and only apply to the package they are created in.

The contents of an enumeration configuration are the mapping of a **`fact.field`** to a list of values. These values are used to populate the drop-down menu. The list can either be literal or use a utility class (which must be added to the classpath) to load the strings. The strings contain either a value to be shown in the drop-down menu or a mapping from the code value (which is what is used in the rule) and a display value, e.g., M=Mini.

Example 6.2. An Example Enumeration Configuration

```
'Board.type' : [ 'Short', 'Long', 'M=Mini', 'Boogie']
'Person.age' : [ '20', '25', '30', '35' ]
```

This can be also be configured in Business Central as follows:

6.7.2. Advanced Enumeration Concepts

Drop-down lists are dependent on field values. With enumerations it is possible to define multiple options based on other field values.

A fact model for insurance policies could have a class called Insurance, consisting of the fields, **policyType** and **coverage**. The choices for**policyType** could be **Home** or **Car**. The type of insurance policy will determine the type of coverage that will be available. A home insurance policy could include **property** or **liability**. A car insurance policy could include **collision** or **fullCoverage**.

The field value policyType determines which options will be presented for coverage, and it is expressed as follows:

```
'Insurance.policyType' : ['Home', 'Car']
'Insurance.coverage[policyType=Home]' : ['property', 'liability']
'Insurance.coverage[policyType=Car]' : ['collision', 'fullCoverage']
```

6.7.3. Obtaining Data Lists from External Sources

A list of Strings from an external source can be retrieved and used in an enumeration menu. This is achieved by adding code to the classpath that returns a **java.util.List** (of strings). Instead of specifying a list of values in the user interface, the code can return the list of strings. (As normal, you can use the "=" sign inside the strings if you want to use a different display value to the rule value.) For example, you could use the following:

```
'Person.age' : ['20','25', '30', '35']
```

To:

```
'Person.age' : (new com.yourco.DataHelper()).getListOfAges()
```

This assumes you have a class called **DataHelper** which has a method**getListOfAges()** which returns a list of strings. The data enumerations are loaded the first time the guided editor is used in a session. To check the enumeration has loaded, go to the package configuration screen. You can "save and validate" the package; this will check it and provide feedback about any errors.

6.8. SCORECARDS

6.8.1. Scorecards

Scorecard is a Risk Management tool which is a graphical representation of a formula used

to calculate an overall score. It is mostly used by financial institutions or banks to calculate the risk they can take to sell a product in market. Thus it can predict the likelihood or probability of a certain outcome. Red Hat JBoss BRMS now supports additive scorecards that calculates an overall score by adding all partial scores assigned to individual rule conditions.

Additionally, Drools Scorecards allows for reason codes to be set, which help in identifying the specific rules (buckets) that have contributed to the overall score. Drools Scorecards will be based on the PMML 4.1 Standard.

In general, a scorecard can be created more or less in this way:

1. A statistical analysis is performed on the historical data which is usually collected from the existing customer database.

2. A predictive or probable characteristics (attributes or pieces of information) are identified based on this analysis.

3. Each characteristics are then broken down into ranges of possible values which are then given a score.

To explain it in detail, following is an example:

Figure 6.35. Scorecard Example

Characteristics	Expected Score	Range	Score
Family Income	50	1 - 30000	10
		30001 - 60000	25
		60001 - 90000	40
		90001 - 120000	65
		Over 120000	75

6.8.2. Creating a Scorecard

Procedure: Creating a new Score Card (Spreadsheet)

1. Open the **Project Authoring** perspective: on the main menu, click**Authoring → Project Authoring**.

2. In the **Project Explorer** view, do the following:

   a. If in the Project view of Project Explorer, select the organizational unit, repository and the project where you want to create the score card.

   b. If in the Repository view of Project Explorer, navigate to the project root, where you want to create the score card.

3. In the perspective menu, go to **New Item → Score Card (Spreadsheet)**.

4. In the **Create new Score Card (Spreadsheet)** dialog window, define the package details:

   a. In the **Resource Name** text box, enter the score card name.

   b. Click on **Choose File** and browse to the location to select the spreadsheet in

which the score card is initially created.

5. Click **OK**.

6. The new score card spreadsheet is created under the selected project.

When you build your own application comprising guided scorecards, ensure that you have the necessary dependencies added to your classpath. For more information on dependencies for guided decision tables, see the *Dependency Management for Guided Decision Tables, Scorecards, and Rule Templates* section of the *Red Hat JBoss BRMS Development Guide*.

6.9. GUIDED DECISION TREES

A decision tree is a graphical representation of a decision model in a tree-like manner. You can create simple decision trees in Business Central with flat data object models. The editor does not support nested data objects.

The editor offers a palette on the left-hand side (with available data objects, fields and corresponding actions) and a working area on the right-hand side where you can drag and drop the data objects to build a decision tree. You can use connectors and applicable child objects prompted by the editor, to complete your tree. You can manipulate each node using its **Delete**, **Edit**, and **Collapse** icons.

While creating a decision tree, you must remember the following points:

- A tree must have a data object at the root.
- A tree can only have one root.
- Data objects can have other data objects, field constraints, or actions as children.
- The field constraints must be on fields of the same data object as the parent node.
- Field constraints can have either other field constraints or actions as children.
- The field constraints must be on fields of the same data object as the parent node.
- Actions can only have other actions as children.

NOTE

Guided Decision Trees and Scorecards are Technology Preview features, and therefore *not* currently supported in Red Hat JBoss BRMS.

6.10. VERIFICATION AND VALIDATION OF GUIDED DECISION TABLES

In Business Central, the guided decision tables are a way of representing conditional logic (rule) in a precise manner, and they are well suited to business level rules.

6.10.1. Introduction

Business Central provides verification and validation feature to help ensure that a guided decision table is complete and error free. The feature looks for gaps in the logic of a guided

decision table and validates the relationship between different cells. Most of the issues that the Business Central verification and validation feature reports are gaps in the author's logic. The verification and validation feature does not prevent you from saving your work if you choose to ignore the verification and validation notifications.

When you edit a guided decision table, the verification and validation feature notifies you if you do something wrong. For example, if you forget to set an action for a row of the guided decision table or if you have a duplicate row, a new panel, Analysis, will open in the Business Central with a notification about the issue. The Analysis panel presents a list of issues found in the guided decision table, each item also pointing out the affected guided decision table rows. If you select an item in the list of issues, you will see a more in-depth description of the problem.

The validation and verification feature helps you resolve issues around:

- Redundancy
  Redundancy happens when two rows in a decision table execute the same consequences for the same set of facts. For example, two rows checking a client's birthday and providing a birthday discount may result in double discount.

- Subsumption
  Subsumption is similar to redundancy and exists when two rules execute the same consequences, but one executes on a subset of facts of the other. For example, these two rules:

  - when Person age > 10 then Increase Counter

  - when Person age > 20 then Increase Counter

  In this case, if a person is 15 years old, only one rule fires and if a person is 20 years old, both rules fire. Such cases cause similar trouble during runtime as redundancy.

- Conflicts
  A conflicting situation occurs when two similar conditions have different consequences. Sometimes, there may be conflicts between two rows (rules) or two cells in a decision table.

  The example below illustrates conflict between two rows in a decision table:

  - when Deposit > 20000 then Approve Loan

  - when Deposit > 20000 then Refuse Loan
    In this case, there is no way to know if the loan will be approved or not.

    The example below illustrates conflict between two cells in a decision table:

  - When Age > 25

  - When Age < 25

  A row with conflicting cells never execute.

- Defiency
  Defiency is similar to a conflict and occurs due to incompleteness in the logic of a rule in a decision table. For example, consider the following two deficient rules:

  - when Age > 20 then Approve Loan

- when Deposit < 20000 then Refuse Loan

These two rules may lead to confusion for a person who is over 20 years old and have deposited less than 20000. You may add more constraints to avoid the conflict after noticing the warning to make your rule logic complete.

- Missing Columns
  In some cases, usually by accident, the user can delete all the condition or action columns. When the conditions are removed all the actions are executed and when the actions columns are missing the rows do nothing. Both may or may not be by design, usually though this is a mistake.

6.10.2. Reporting

The verification and validation feature of Business Central reports different issue levels in the Analysis panel while you are updating a guided decision table.

- Error: This means a serious fault, which may lead to the guided decision table failing to work as designed at run time. Conflicts, for example, are reported as errors.
- Warning: This is most likely a serious fault, however they may not prevent the guided decision table from working but need to be double checked. Warnings are used e.g. for subsumption.
- Information: This kind of issues might be a design decision of the author of the guided decision table as well as a simple accident. This is used e.g. for a row missing any condition.

NOTE

Business Central verification and validation does not prevent you from saving an incorrect change. The feature only reports issues while editing and you can still continue to overlook those and save your changes.

6.10.3. Disabling Verification and Validation of Guided Decision Tables

The decision table verification and validation feature of Business Central is enabled by default. You can disable it by setting the **`org.kie.verification.disable-dtable-realtime-verification`** system property value to **`true`**.

For example, if you are using JBoss EAP as your application server, navigate to **`$EAP_HOME`** directory and run the following command:

```
./standalone.sh -Dorg.kie.verification.disable-dtable-realtime-
verification=true
```

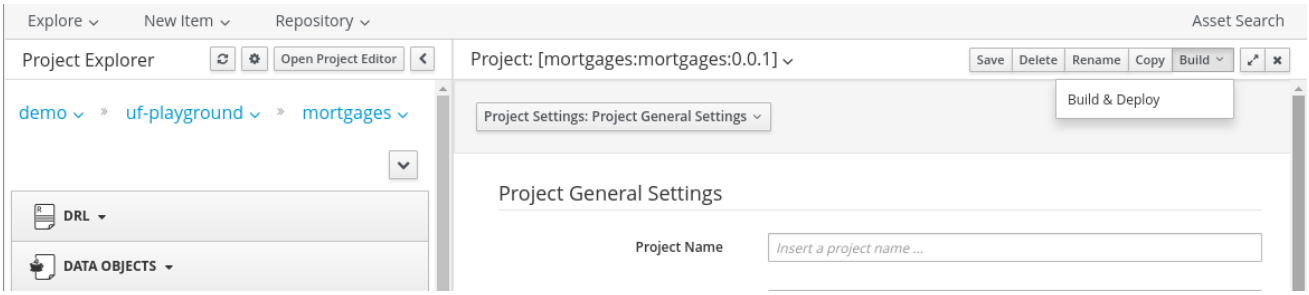
Alternatively, set this property in the **`standalone.xml`** file:

```
<property name="org.kie.verification.disable-dtable-realtime-verification"
value="true"/>
```

CHAPTER 7. BUILDING AND DEPLOYING ASSETS

Click **Build & Deploy** as shown in the following screen to build and deploy packages and assets.

Figure 7.1. Build & Deploy Option



The **Problems** window below the project screen displays error messages (for example compilation errors) that can cause a failure in the build.

You can choose to build the whole package, or its subset.

If a project contains a large number of assets (rules, decision tables, or others), the build process may be slower than usual. After a successful build, you can download the binary package as a JAR file under **Authoring → Artifact Repository**.

7.1. DUPLICATE GAV DETECTION

Every time you perform any of the operations listed below, all Maven repositories are checked for duplicate **`GroupId`**, **`ArtifactId`**, and **`Version`**. If a duplicate exists, the performed operation is cancelled.

The duplicate GAV detection is executed every time you:

- Create a new managed repository.
- Save a project definition in the Project Editor.
- Add new modules to a managed multi-module repository.
- Save the **`pom.xml`** file.
- Install, build, or deploy a project.

The following Maven repositories are checked for duplicates:

- Repositories specified in the **`<repositories>`** and **`<distributionManagement>`** elements of the **`pom.xml`** file.
- Repositories specified in the Maven's **`settings.xml`** configuration file.

Users with the **`admin`** role can modify the list of affected repositories. To do so, open your project in the Project Editor and click **Project Settings: Project General Settings → Validation**.

Figure 7.2. List of Repositories to Be Checked

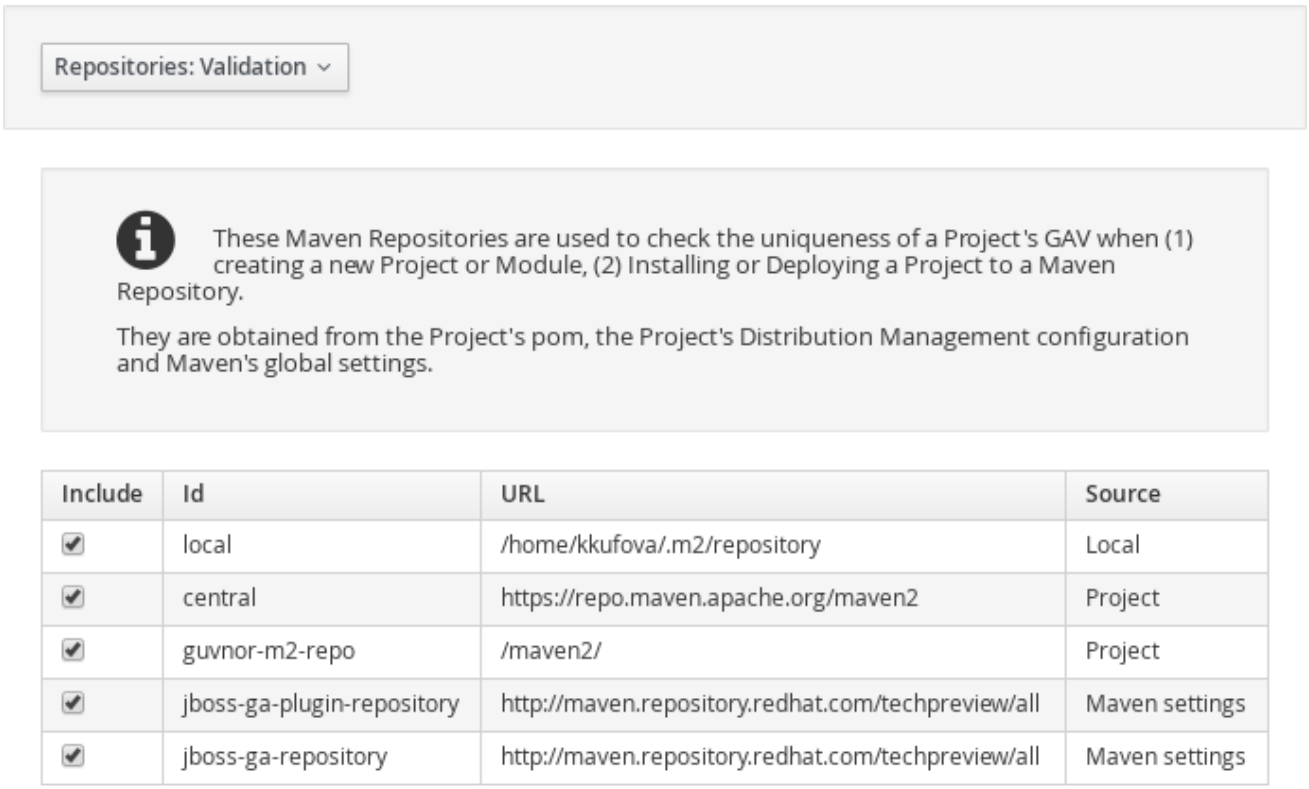


Figure 7.3. Duplicate GAV Detected

NOTE

To disable this feature, set the **`org.guvnor.project.gav.check.disabled`** system property to **`true`**.

CHAPTER 8. MANAGING ASSETS

8.1. VERSIONS AND STORAGE

Business rules, process definition files, and other assets and resources created in Business Central are stored in Artifact Repository (Knowledge Store), that is accessed by the Realtime Execution Server.

Knowledge Store is a centralized repository for your business knowledge. It connects multiple repositories (currently only GIT repositories are supported) so that you can access them from a single environment while allowing you to store different kinds of knowledge and artifacts in different locations. Business Central provides a web front-end that allows users to view and update the store content. You can access the Knowledge Store from the unified environment of Red Hat JBoss BRMS in the **Project Editor** and **Project Explorer** under the **Authoring Perspective**.

GIT is a distributed version control system and it implements revisions as commit objects. Every time you commit your changes into a repository this creates a new commit object in the GIT repository. Similarly, the user can also copy an existing repository. This copying process is typically called cloning and the resulting repository can be referred to as clone. Every clone contains the full history of the collection of files and a cloned repository has the same content as the original repository.

CHAPTER 9. TESTING

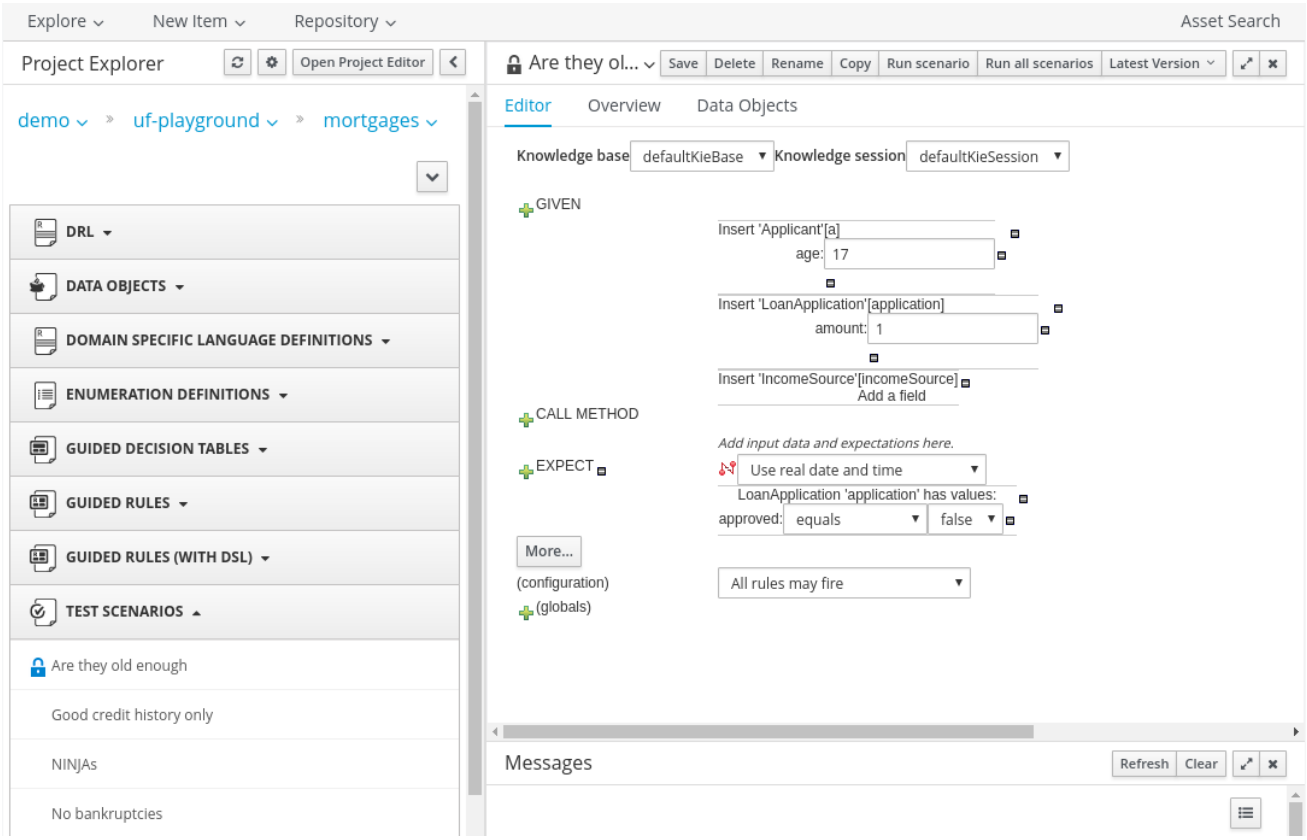
9.1. TEST SCENARIOS

Test Scenarios is a powerful feature that provides the ability for developers to validate the functionality of rules, models, and events. In short, Test Scenarios provide you the ability to test your knowledge base before deploying it and putting it into production.

Test Scenarios can be executed one at the time or as a group. The group execution contains all the Scenarios from one package. Test Scenarios are independent, one Scenario can not affect or modify the other.

After running all the Test Scenarios a report panel is shown. It contains either a success message or a failure message for test scenarios that were run.

Figure 9.1. Test Scenario Screen



9.2. CREATING A TEST SCENARIO

Creating a Test Scenario requires you to provide data for conditions which resemble an instance of your fact or project model. This is matched against a given set of rules and if the expected results are matched against the actual results, the Test Scenario is deemed to have passed.

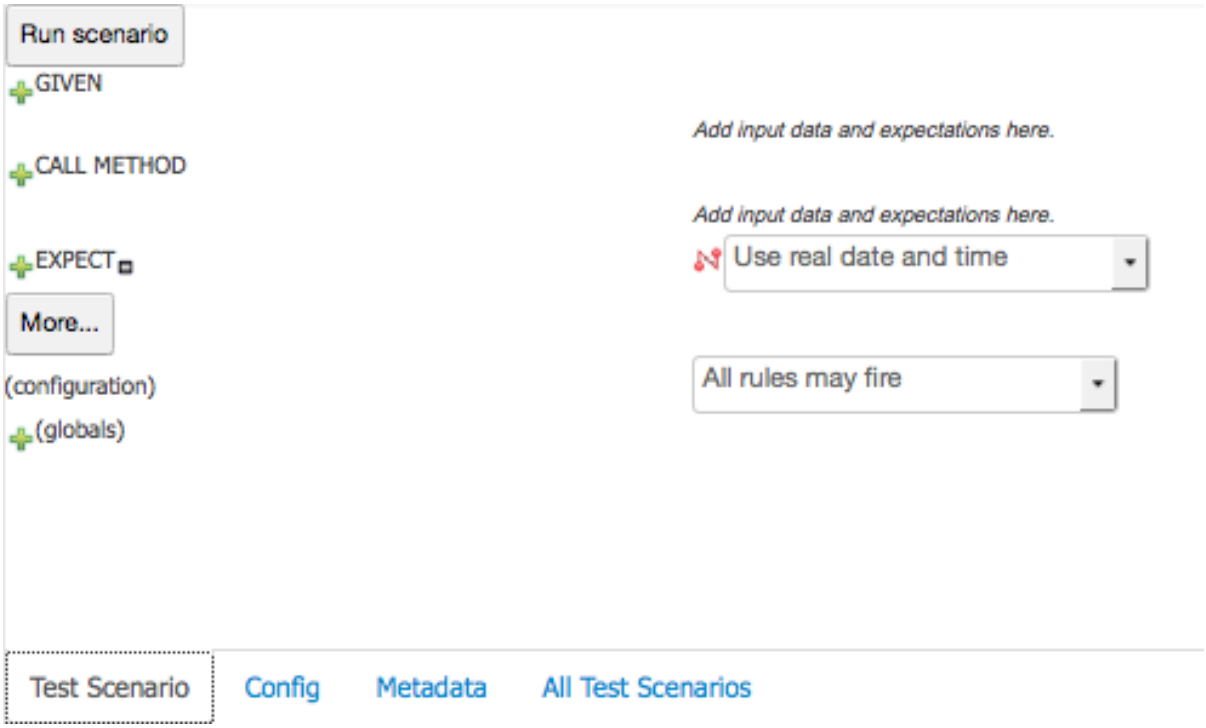
Procedure: Creating a new Test Scenario

1. Open the **Projects** view from the **Project Authoring** menu.
2. Select the project where the test scenario is to be created.

3. From the **New Item** dropdown menu on the toolbar, select **Test Scenario** from the listed options.

4. Enter the Test Scenario name in the pop-up dialog box and click **OK**.

5. You will be presented with the Test Scenario edit screen.



Procedure: Importing a model for the Test Scenario

1. Use the tabs at the bottom of the screen to move between the **Test Scenario** edit screen and the **Config** edit screen.

2. The **Config** screen allows you to specify the model objects that you will be using in this Test Scenario.

3. Data objects from the same package are available by default. For example, if you have a package structure **`org.company.project`**, and you have a data object Fact1 in package **`org.company`** and a Fact2 in package **`org.company.project`**, you will not have to import model objects for Fact1 if you want to create a Test Scenario in package **`org.company`**; however, you will need to import Fact2 if you want to use it.

4. To import the data objects that are required for your Scenario, click on the **New Item** button in the **Config** screen.

5. These imports can be specific to your project's data model or generic ones like **`String`** or **`Double`** objects.

Procedure: Providing Test Scenario Facts

1. After you have imported the data objects, come back to the Test Scenario screen and enter the variables for your Scenario.

2. At the minimum, there are two sections that require input: **GIVEN** and **EXPECT**

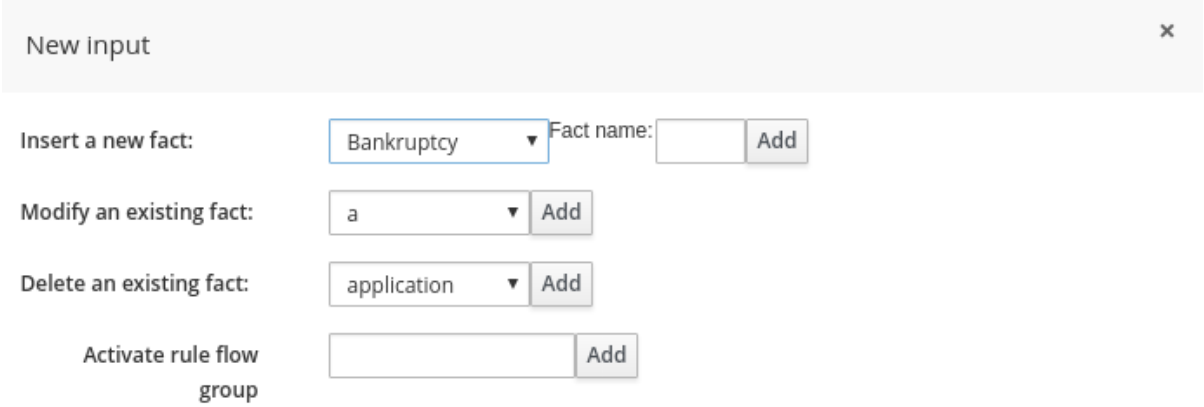
   - GIVEN: What are the input facts for this Test Scenario?

- EXPECT: What are the expected results given the input facts from the **GIVEN** section?

3. **GIVEN** these input parameters, **EXPECT** these rules to be activated or fired. You can also **EXPECT** facts to be present and to have specific field values or **EXPECT** rules not to fire at all.
   If the expectations are met, then the Test Scenario has passed and your rules have been created correctly. If the expectations are not met, then the Test Scenario has failed and you need to check your rules.

Procedure: Providing Given Facts

1. To add a new fact, click on the green + button next to the **GIVEN** label. This will bring up the **New Input** dialog box. Provide your fact data in this window based on the data models that you have imported in the **Config** screen.



   You can select a particular data object from the model and give it a variable name (called **Fact Name** in the window), or choose to activate a rule flow group instead. If you choose to activate a rule flow group, you are allowing rules from a rule flow group to be tested by activating the group in advance. If you want to add a given fact and activate a rule flow group, you have to add the given fact, click the green + button again, and then add the activation.

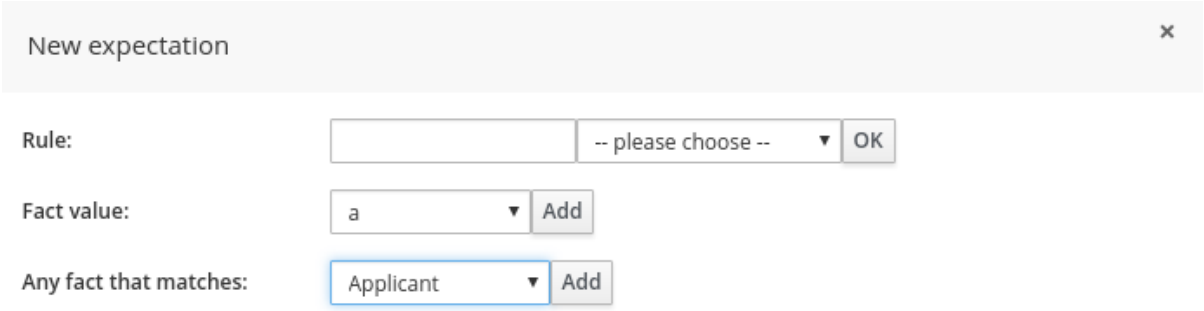
2. Depending upon the model that you select, you will be able to provide values to its editable properties as part of your GIVEN fact. For example, if your model was a **`Product`**, you might have properties like **`itemID`**, **`productName`** and **`price`**. You get to these properties by clicking on the text **`Insert Product`**.

   By clicking on the pencil icon next to the property, you can edit the property to provide either a literal value for that property that should form part of your GIVEN fact data or you can provide advanced fact data. See Section 9.3, “Additional Test Scenario Features” for more information.

Procedure: Providing Expected Rules

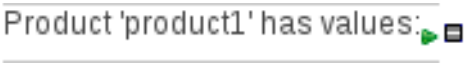
1. Once you are satisfied with the Given rule conditions, you can expect that rules that will be fired if the Given rule conditions are met when the Test Scenario is run.

2. To do so, click on the green + button next to the **EXPECT** label. A **New expectation** dialog box will come up.



3. You can provide one of three expectations given the set of data that was created in the Given section. You can:

   - Either type in the name of a rule that is expected to be fired or select it from the list of rules and then click the **OK** button.

   - Expect a particular instance of a model object (and one or more of its properties) to have a certain value by selecting that instance from the drop down in the **Fact Value** field. For example, **`product1`** shown in the figure, which is an instance of the fictitious **`Product`** model created in the Given section. You specify the property values by first adding that instance by clicking the **Add** button and then clicking a green arrow 

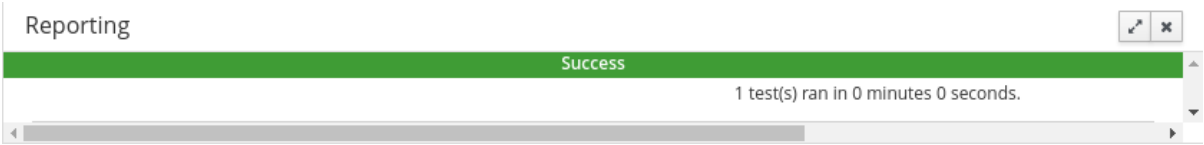
to bring up the fields to add. Once you have selected the field to add, you can provide a literal value for that field.

   - Expect a fact model to match your Given facts by selecting it from the **Any fact that matches** drop down. Instances of data objects are in the working memory, rather than matching what has been set up in the Given section. Rules may change the contents of working memory for example, some facts may be retracted, others inserted, and some will have their properties changed.
     In the figure shown above, you can mandate that instances of the Product's one or more properties match the Given rule conditions.

Procedure: Reviewing, Saving, and Running a Scenario

1. Once you are satisfied with your Test Scenario's facts, you can save it by clicking the **Save** button in the upper right corner. Ensure you regularly save and review your scenarios.

2. You can now run your Test Scenario by clicking the **Run scenario** button at the top of the Test Scenario screen. The results are displayed at the bottom of this screen in a new panel called **Reporting**.



3. Once you have a bunch of Test Scenarios for a particular package, you can run all of them together by accessing the **All Test Scenarios** tab and then clicking the **Run all scenarios** button.

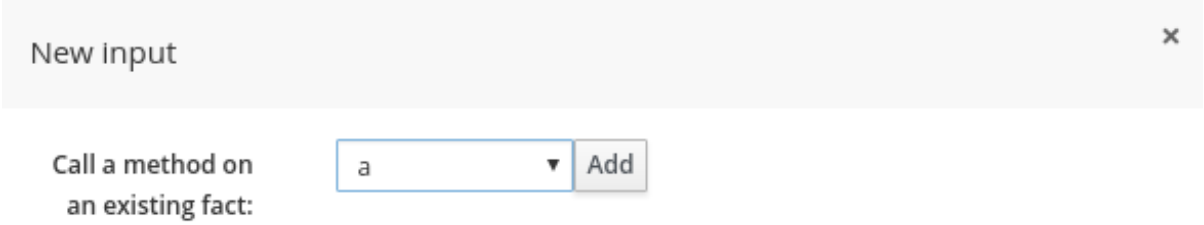
9.3. ADDITIONAL TEST SCENARIO FEATURES

In addition to the previous Test Scenario features, which encompassed the **GIVEN** and **EXPECT** input facts, Red Hat JBoss BRMS Test Scenarios include various other features.

Procedure: Calling Methods

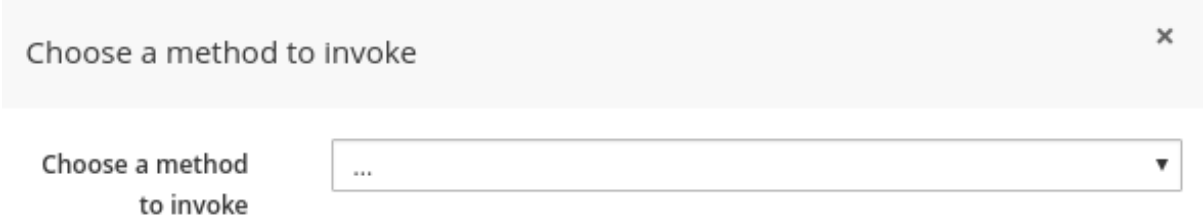
1. **`Call Method`** - allows you to call a method on an existing fact in the beginning of the rule execution. This feature is accessed by clicking on the green plus sign next to the **CALL METHOD** feature. This opens up a new input box like the following:

   Figure 9.2. Call Method

2. After selecting an existing fact from the drop-down list, click the Add button. The green arrow button allows you to call a method on the fact.

   Figure 9.3. Invoke a Method

Procedure: Adding Globals

1. **`globals`** - validate the global field values. Globals are named objects that are visible to the rule engine but are different from the objects for facts. Accordingly, the changes in the object of a global do not trigger the reevaluation of rules. This feature is accessed by clicking on the green plus sign next to the **(globals)** feature.

   Figure 9.4. New Global

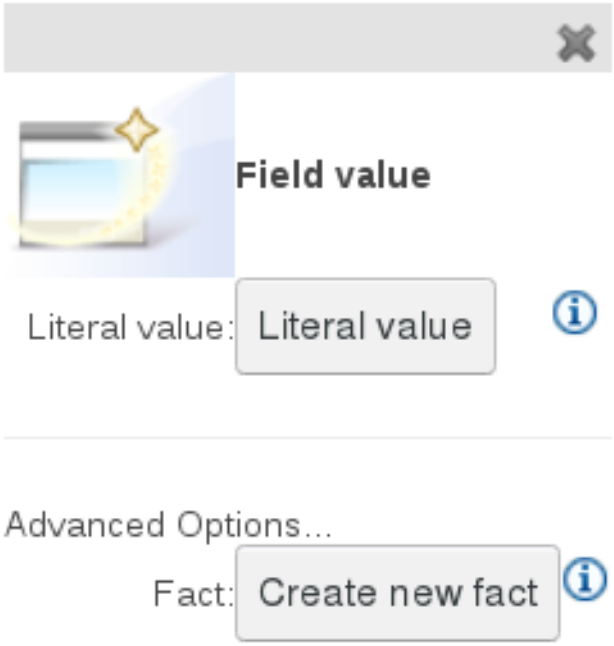
   

2. After selecting an existing global from the drop-down list, click the Add button. Clicking on the newly selected global allows you to assign values to fields of the global variable.

Figure 9.5. Apply Field

3. After selecting an existing field from the drop-down list, click the OK button. Once you have selected the field, you will be able to set its value.  By clicking on this icon, you will be able to edit the field values.

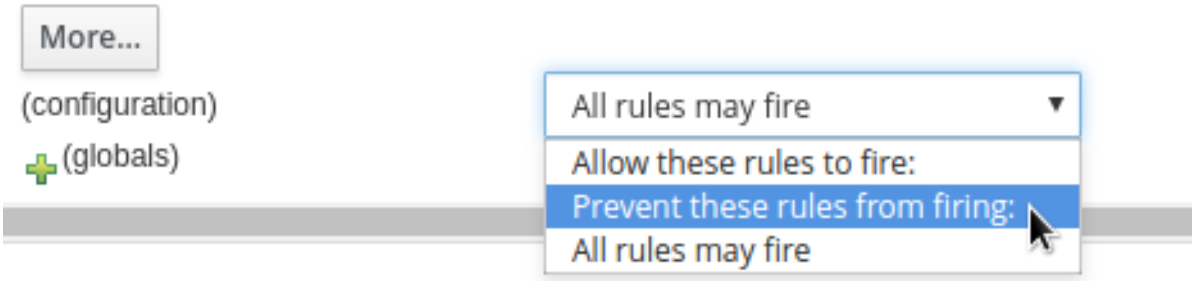
Figure 9.6. Field Values



Procedure: Configuring Rules

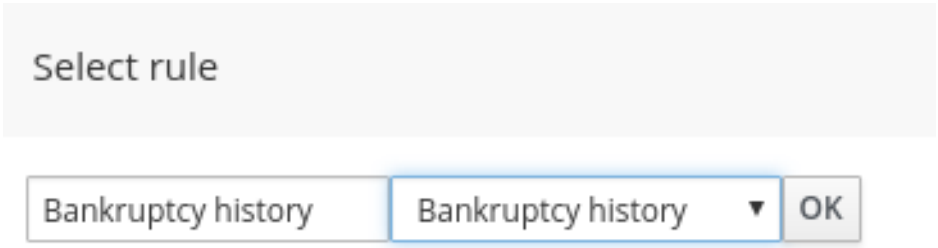
1. **`Configuring rules`** - allows the user to determine additional constraints on the firing of rules by providing the following options:
   - **`Allow these rules to fire:`** - allows you to select which rules are allowed to fire.
   - **`Prevent these rules from firing:`** - allows you to prevent certain rules from firing for the test scenario.
   - **`All rules may fire`** - will allow all the rules to fire for the given test.

Figure 9.7. Configuration



2. If you select **`Allow these rules to fire:`** or **`Prevent these rules from firing:`**, you will be supplied with an empty field where you can select the rules which pertain to the configuration by clicking the green plus sign next to the empty field. This will open a dialog to select which rules are affected by the condition.

Figure 9.8. Selecting rules

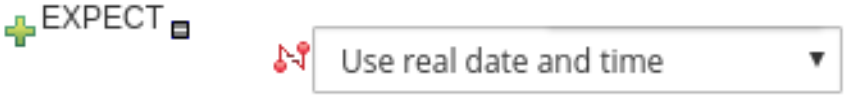


3. Choose a rule from the drop-down list and click the OK button. The selected rules will appear in the field next to the rules configuration option. You can add as many rules as you like to this field.

Procedure: Date and Time Configuration

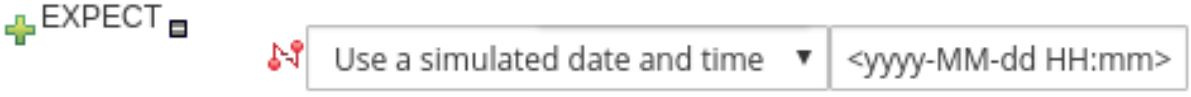
1. **`Use real date and time`** - the real time is used when running the test scenario.

Figure 9.9. Real Date and Time



2. **`Use a simulated date and time`** - this option allows you to specify the year, month, day, hour, and minute associated with the test scenario run.

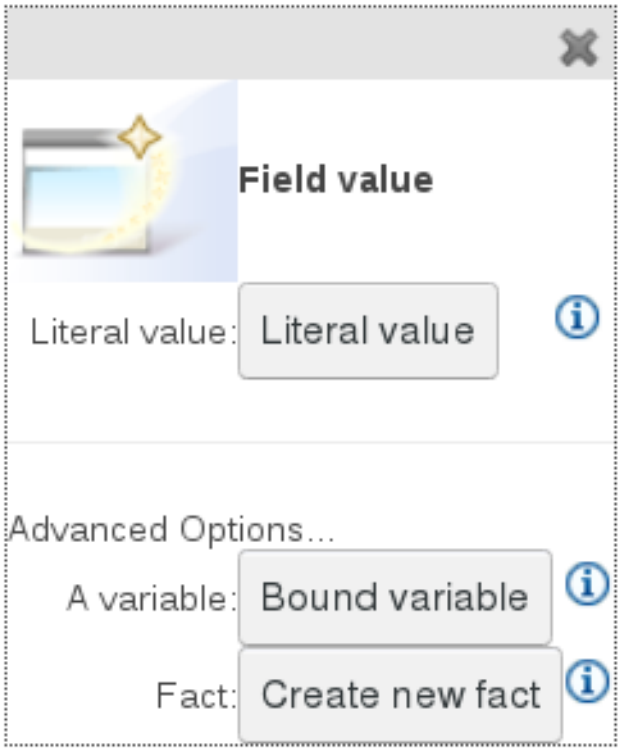
Figure 9.10. Title



Procedure: Advanced Fact Data

1. After providing values to editable properties as part of your created fact, the Field value dialog box will appear where you can edit literal values or provide advanced fact data.

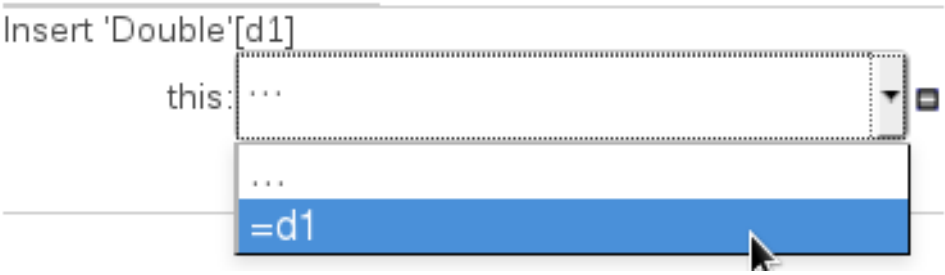
Figure 9.11. Advanced Options



2. Within the Advanced Options section, you will be provided with various choices depending on the type of fact created and the model objects used for the particular Test Scenario.

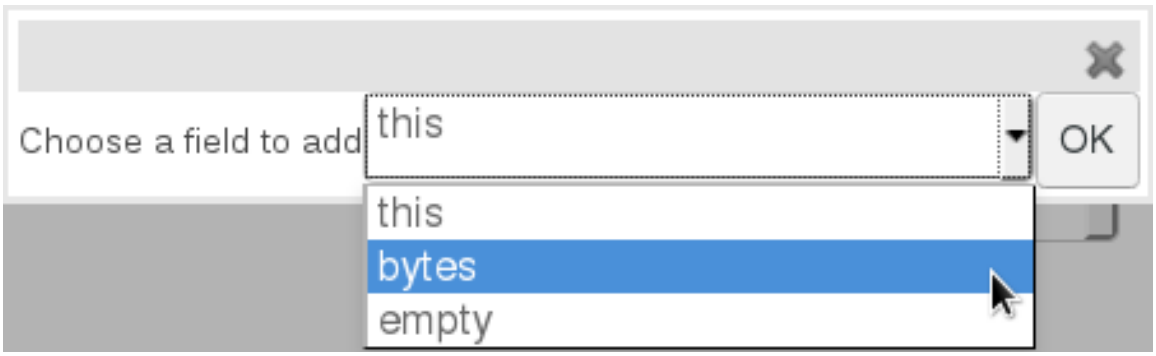
   - **`Bound variable`** - sets the value of the field to the fact bout to the selected variable. The field must be of the right type.

     Figure 9.12. Bound Variable

   - **`Create new fact`** - allows you to create a new fact. By clicking on the **Create new fact** button, a new fact will appear as the value of the field. By clicking on that fact, you will be supplied with a drop down of various field values, and these values may be given further field values.

Figure 9.13. Create New Fact



Procedure: Adding More Sections

- The Test Scenario edit screen allows you to add Given, Call Method, and Expect sections to the scenario by clicking the **More** 

button below the **EXPECT** section. This will open a block encompassing all three sections that can be removed by clicking the delete item  button.

Procedure: Modifying or Deleting an Existing Fact

- **`Modifying an existing fact`** - allows the editing of a fact between knowledge base executions.
- **`Delete an existing fact`** - allows the removing of facts between executions.

  Figure 9.14. Modifying and Deleting Existing Facts

CHAPTER 10. REALTIME DECISION SERVER

The Realtime Decision Server is a standalone, out-of-the-box component that can be used to instantiate and execute rules through interfaces available for REST, JMS or a Java client side application. Created as a web deployable WAR file, this server can be deployed on any web container. The current version of the Realtime Decision Server ships with default extensions for both JBoss BRMS and JBoss BPM Suite.

This server has a low footprint, with minimal memory consumption, and therefore, can be deployed easily on a cloud instance. Each instance of this server can open and instantiate multiple KIE Containers which allows you to execute multiple rule services in parallel.

You can provision the Realtime Decision Server instances through Business Central. In this chapter, you will go through the steps required to setup the Realtime Decision Server, provision and connect to this server through Business Central, control what rule artifacts go in each instance and go through its lifecycle.

10.1. DEPLOYING THE REALTIME DECISION SERVER

The Realtime Decision Server is distributed as a web application archive (WAR) file with the name of **kie-server.war**. When you install Red Hat JBoss BRMS, this WAR file is installed and deployed in your web container by default.

You can copy this WAR file and deploy it in any other web container (Red Hat JBoss Web Server or another Red Hat JBoss EAP install, for example) and have this server available from other web containers. Note that you must deploy the WAR file that is compatible for your web container.

1. Once you have deployed the WAR file (or if you have it deployed on the same web container where Red Hat JBoss BRMS is deployed), create a user with the role of **kie-server** in this web container.

2. Test that you can access the decision engine by navigating to the endpoint in a browser window: **http://SERVER:PORT/kie-server/services/rest/server/** with the web container running. You will be prompted for your username/password that you created in the previous step.

3. Once authenticated, you will see an XML response in the form of engine status, similar to this:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<response type="SUCCESS" msg="Kie Server info">
 <kie-server-info>
  <capabilities>BPM</capabilities>
 <capabilities>KieServer</capabilities>
 <capabilities>BRM</capabilities>
 <location>http://localhost:8230/kie-
server/services/rest/server</location>
 <name>KieServer@/kie-server</name>
 <id>15ad5bfa-7532-3eea-940a-abbbbc89f1e8</id>
 <version>6.4.0.Final-redhat-5</version>
 </kie-server-info>
</response>
```

10.2. INSTALLING THE REALTIME DECISION SERVER IN

OTHER CONTAINERS

10.2.1. JBoss Web Server 2.x/3.x, Tomcat 8.x/9.x

Use the following procedure to install the Realtime Decision Server in a Tomcat container.

Procedure:

1. Download and unzip the Tomcat distribution.
2. Download **kie-server-6.4.0.Final-webc.war** and place it into **TOMCAT_HOME/webapps**.
3. Configure user(s) and role(s). Make sure that **TOMCAT_HOME/conf/tomcat-users.xml** contains the following username and role definition. The username and password should be unique, however ensure that the user has the role **kie-server**:

```
<role rolename="kie-server"/>
<user username="serveruser" password="my.s3cr3t.pass" roles="kie-
server"/>
```

4. Start the server by running **TOMCAT_HOME/bin/startup.[sh|bat]**. You can check out the Tomcat logs in **TOMCAT_HOME/logs** to see if the application deployed successfully. See Section 10.3.1, “Bootstrap Switches” for the bootstrap switches that can be used to properly configure the instance. For instance:

```
$ ./startup.sh -Dorg.kie.server.id=first-kie-server -
Dorg.kie.server.location=http://localhost:8080/kie-
server/services/rest/server
```

5. Verify the server is running. Access **http://SERVER:PORT/kie-server/services/rest/server/** and type the specified username and password. You should see simple XML message with basic information about the server.

IMPORTANT

You cannot leverage the JMS interface when running on Tomcat, or any other Web container. The Web container version of the WAR contains only the REST interface.

10.3. REALTIME DECISION SERVER SETUP

10.3.1. Bootstrap Switches

The Realtime Decision Server accepts a number of bootstrap switches (system properties) to configure the behavior of the server. The following is a table of all the supported switches:

NOTE

Some properties are marked as required when using a controller, so you need to set these properties when you handle Realtime Decision Server container creation and removal in Business Central. If you use the Realtime Decision Server separately—without any interaction with Business Central—you do not have to set these properties.

Realtime Decision Server Bootstrap Switches

kie.maven.settings.custom

The location of a custom **`settings.xml`** file for Maven configuration.

Values	Default
Path	N/A

kie.server.jms.queues.response

The JNDI name of response queue for JMS.

Values	Default
String	**`queue/KIE.SERVER.RESPONSE`**

org.drools.server.ext.disabled

When set to **`true`**, disables the BRM support (for example rules support).

Values	Default
`true` or **`false`**	**`false`**

org.drools.server.filter.classes

When set to **`true`**, the Drools Realtime Decision Server extension accepts custom classes annotated by **`XmlRootElement`** or **`Remotable`** annotations only.

Values	Default
`true` or **`false`**	**`false`**

org.kie.executor.disabled

Disables the Red Hat JBoss BRMS executor.

Values	Default
`true` or **`false`**	**`false`**

org.kie.executor.interval

The time between the moment the Red Hat JBoss BRMS executor finishes a job and the moment it starts a new one, in a time unit specified in **`org.kie.executor.timeunit`**.

Values	Default
Number (**`Integer`**)	3

org.kie.executor.pool.size

The number of threads used by the Red Hat JBoss BRMS executor.

Values	Default
Number (**`Integer`**)	1

org.kie.executor.retry.count

The number of retries the Red Hat JBoss BRMS executor attempts on a failed job.

Values	Default
Number (**`Integer`**)	3

org.kie.executor.timeunit

The time unit in which the **`org.kie.executor.interval`** is specified.

Values	Default
A **`java.util.concurrent.TimeUnit`** constant	**`SECONDS`**

org.kie.server.controller

A comma-separated list of URLs to controller REST endpoints, for example **`http://localhost:8080/business-central/rest/controller`**. This property is required when using a controller.

Values	Default
Comma-separated list	N/A

org.kie.server.controller.connect

The waiting time between repeated attempts to connect Realtime Decision Server to the controller when Realtime Decision Server starts up, in milliseconds.

Values	Default
Number (**`Long`**)	**`10000`**

org.kie.server.controller.pwd

The password to connect to the controller REST API. This property is required when using a controller.

Values	Default
String	**kieserver1!**

org.kie.server.controller.token

This property allows you to use a token-based authentication between the KIE server and the controller instead of the basic user name/password authentication. The KIE server sends the token as a parameter in the request header. Note that long-lived access tokens are required as the tokens are not refreshed.

Values	Default
String	N/A

org.kie.server.controller.user

The user name to connect to the controller REST API. This property is required when using a controller.

Values	Default
String	**kieserver**

org.kie.server.domain

The JAAS **LoginContext** domain used to authenticate users when using JMS.

Values	Default
String	N/A

org.kie.server.id

An arbitrary ID to be assigned to this server. If a remote controller is configured, this is the ID under which the server will connect to the controller to fetch the KIE container configurations. If not provided, the ID is automatically generated.

Values	Default
String	N/A

org.kie.server.location

The URL of the Realtime Decision Server instance used by the controller to call back on this server, for example: **http://localhost:8230/kie-server/services/rest/server**. This property is required when using a controller.

Values	Default
URL	N/A

org.kie.server.pwd

The password used to connect with the KIE server from the controller, required when running in managed mode. You must set this property in Business Central system properties, and it is required when using a controller.

Values	Default
String	**kieserver1!**

org.kie.server.repo

The location where Realtime Decision Server state files will be stored.

Values	Default
Path	**.**

org.kie.server.sync.deploy

Instructs the KIE server to hold the deployment until the controller provides the containers deployment configuration. This property affects only the KIE servers running in managed mode. The options are as follows:

- **false**; the connection to the controller is asynchronous. The application starts, connects to the controller and once successful, deploys the containers. The application accepts requests even before the containers are available.
- **true**; the deployment of the KIE server application joins the controller connection thread with the main deployment and awaits its completion.
  This option can lead to a potential deadlock in case more applications are on the same server instance. It is strongly recommended to use only one application (the KIE server) on one server instance.

Values	Default
true or **false**	**false**

org.kie.server.token

This property allows you to use a token-based authentication between the controller and the KIE server instead of the basic user name/password authentication. The controller sends the token as a parameter in the request header. Note that long-lived access tokens are required as the tokens are not refreshed.

Values	Default
String	N/A

org.kie.server.user

The user name used to connect with the KIE server from the controller, required when running in managed mode. This property need to be set in Business Central system properties and is required when using a controller.

Values	Default
String	**kieserver**

org.optaplanner.server.ext.disabled

When set to **true**, disables the BRP support (for example planner support).

Values	Default
true or **false**	**false**

IMPORTANT

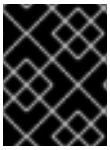
A new DataSource for the Realtime Decision Server must point to a different database schema than the DataSource used by Business Central.

If you are running both the Realtime Decision Server and the Business Central, make sure that each uses a different DataSource (by modifying the **org.kie.server.persistence.ds** property), in order to avoid conflicts.

10.3.2. Managed Realtime Decision Server

A managed instance requires an available controller to start up the Realtime Decision Server.

A Controller is a component that keeps and manages a Realtime Decision Server configuration in a centralized way. Each controller can manage multiple configurations at once, and there can be multiple controllers in the environment. Managed Realtime Decision Server can be configured with a list of controllers, but will only connect to one at a time.

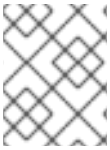


IMPORTANT

Controllers should be kept in sync to ensure that the same set of configuration is provided to the server, regardless of which controller it connects to.

When the Realtime Decision Server is configured with a list of controllers, it will attempt to connect to each of them at startup until a connection is successfully established with one of them. If for some reason a connection cannot be established, the server will not start, even

if there is a local storage available with configuration. This ensures consistence, and prevents the server from running with redundant configuration.



NOTE

To run the Realtime Decision Server in standalone mode without connecting to controllers, see Section 10.3.4, “Unmanaged Realtime Decision Server”.

10.3.3. Registering Realtime Decision Server

To register a new managed Realtime Decision Server instance, set the following properties in **standalone.xml**:

```
<property name="org.kie.server.user" value="anton"></property>
<property name="org.kie.server.pwd" value="password1!"></property>
<property name="org.kie.server.location" value="http://localhost:8080/kie-
server/services/rest/server"></property>
<property name="org.kie.server.controller"
value="http://localhost:8080/business-central/rest/controller"></property>
<property name="org.kie.server.controller.user"
value="kieserver"></property>
<property name="org.kie.server.controller.pwd"
value="kieserver1!"></property>
<property name="org.kie.server.id" value="local-server-123"></property>
```

The **standalone.xml** file is located in the **$SERVER_HOME/standalone/configuration/** directory.

org.kie.server.user must have the **kie-server** role assigned.

WARNING

org.kie.server.location points to the same host as **org.kie.server.controller**. This is not suitable for production.

To create the **kieserver** user:

1. Change into **$SERVER_HOME/bin/**.
2. Execute the following command:

```
$ ./add-user.sh -a --user kieserver --password kieserver1! --role
kie-server
```

To verify successful start of the Realtime Decision Server, send a GET request to **http://SERVER:PORT/kie-server/services/rest/server/**. Once authenticated, you will see an XML response:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
```

```
<response type="SUCCESS" msg="Kie Server info">
    <kie-server-info>
        <capabilities>BRM</capabilities>
        <capabilities>BPM-UI</capabilities>
        <capabilities>BPM</capabilities>
        <capabilities>BRP</capabilities>
        <capabilities>KieServer</capabilities>
        <location>http://localhost:8080/kie-
server/services/rest/server</location>
        <messages>
            <content>Server KieServerInfo{serverId='local-server-123',
version='6.4.0.Final-redhat-3', location='http://localhost:8080/kie-
server/services/rest/server'}started successfully at Fri Jun 03 13:48:44
CEST 2016</content>
            <severity>INFO</severity>
            <timestamp>2016-06-03T13:48:44.606+02:00</timestamp>
        </messages>
        <name>local-server-123</name>
        <id>local-server-123</id>
        <version>6.4.0.Final-redhat-3</version>
    </kie-server-info>
</response>
```

To verify successful registration, log into the Business Central and select **Deploy → Rule Deployments**. If successful, you will see the registered server ID.

10.3.4. Unmanaged Realtime Decision Server

An unmanaged Realtime Decision Server is a standalone instance, and therefore must be configured individually using REST/JMS API from the Realtime Decision Server itself. There is no controller involved. The configuration is automatically persisted by the server into a file and that is used as the internal server state, in case of restarts.

The configuration is updated during the following operations:

- Deploy KIE Container
- Undeploy KIE Container
- Start KIE Container
- Stop KIE Container

NOTE

If the Realtime Decision Server is restarted, it will attempt to re-establish the same state that was persisted before shutdown. Therefore, KIE Containers that were running will be started, but the ones that were stopped will not.

10.4. CREATING A CONTAINER

Once your Realtime Decision Server is registered, you can start adding containers to it. Containers are self-contained environments that have been provisioned to hold instances of your packaged and deployed rule instances. To create a container, follow these steps:

1. Log into Business Central.
2. Click **Deploy** → **Rule Deployment**.
3. In the **SERVER TEMPLATES** section on the left, select your server.
4. Click **Add Container** to see the **New Container** wizard.
5. Add a name of your container under **Name**.
6. Click **Search** and select a built project you wish to deploy into the container. Alternatively, enter **`Group Name`**, **`Artifact Id`** and **`Version`** manually.

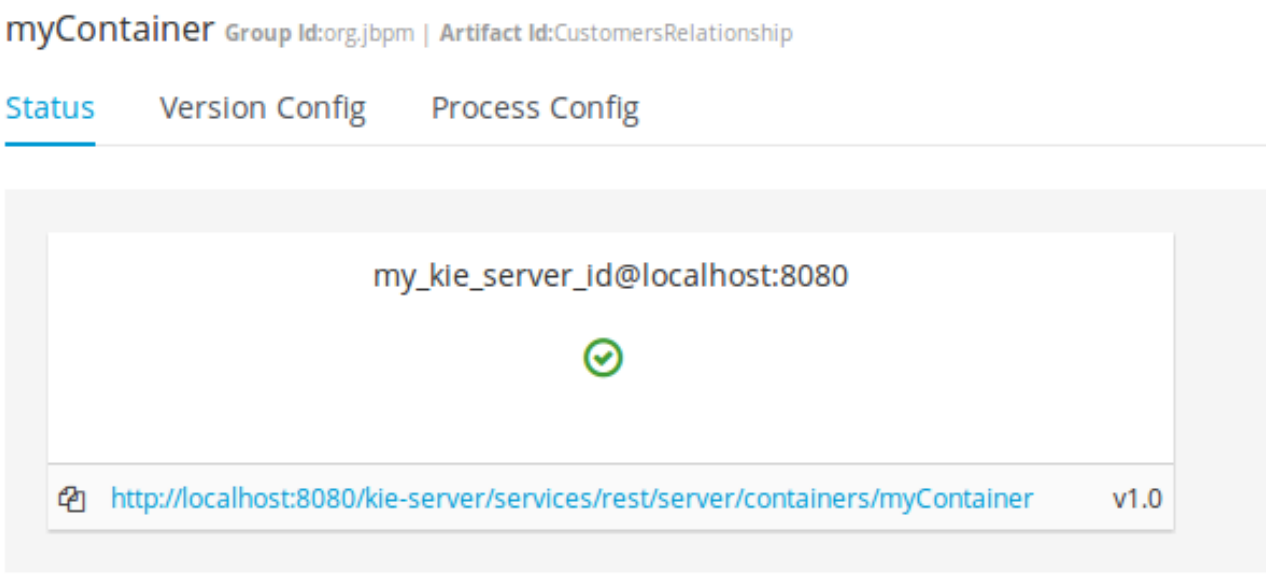
WARNING

When you enter the container version number, do not use the **`LATEST`** or **`RELEASE`** keywords. This feature has been deprecated and can cause deployment issues.

7. Click **Next** to configure Runtime strategy, Kie Base and Kie Session for your container.
   Alternatively, click **Finish** to skip configuration of Runtime strategy, Kie Base and Kie Session for your container.
8. Click **Finish**.

After you successfully create your container, click **Start**.

Figure 10.1. Container in Started Mode



To verify the container is up and running, send a [GET] request to the endpoint.

Example 10.1. Server Response

```
<response type="SUCCESS" msg="Info for container myContainer">
  <kie-container container-id="myContainer" status="STARTED">
    <messages>
      <content>
        Container myContainer successfully created with module
org.jbpm:CustomersRelationship:1.0.
      </content>
      <severity>INFO</severity>
      <timestamp>2016-03-02T11:43:40.806+01:00</timestamp>
    </messages>
    <release-id>
      <artifact-id>CustomersRelationship</artifact-id>
      <group-id>org.jbpm</group-id>
      <version>1.0</version>
    </release-id>
    <resolved-release-id>
      <artifact-id>CustomersRelationship</artifact-id>
      <group-id>org.jbpm</group-id>
      <version>1.0</version>
    </resolved-release-id>
    <scanner status="DISPOSED"/>
  </kie-container>
</response>
```

10.5. MANAGING CONTAINERS

Containers within the Realtime Decision Server can be started, stopped, and updated from within Business Central.

10.5.1. Starting, Stopping, and Deleting a Container

A container is stopped by default. To start it, follow these steps:

1. Log into Business Central.
2. Click **Deploy** → **Rule Deployment**.
3. In the **SERVER TEMPLATES** section on the left, click on your Realtime Decision Server ID.
4. In the **KIE CONTAINERS** section, click on the container you want to start.
5. Click **Start**. Alternatively, click **Stop** to stop a running container. Once a container is stopped, you can click **Remove** to remove it.

10.5.2. Upgrading a Container

You can update deployed containers without needing to restart the Realtime Decision Server. This is useful in cases where the business rule changes cause new versions of packages to be provisioned. You can have multiple versions of the same package provisioned and deployed. To upgrade a container, follow these steps:

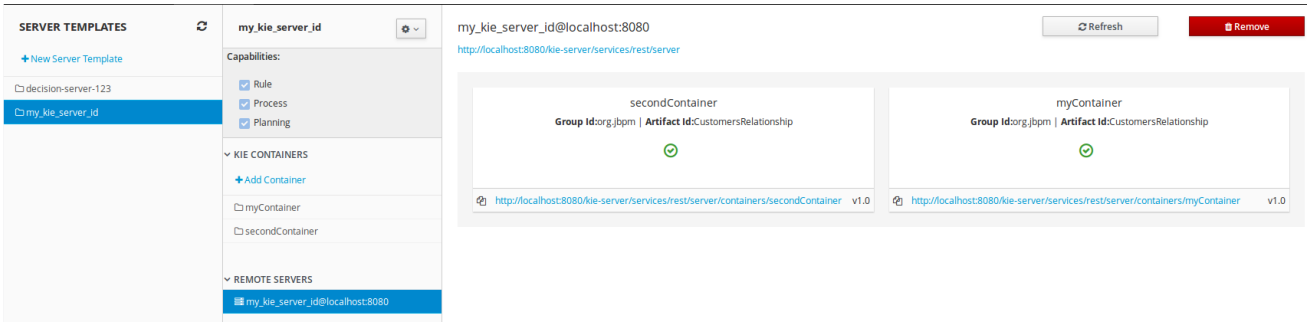
1. Log into Business Central.
2. Click **Deploy** → **Rule Deployment**.
3. In the **KIE CONTAINERS** section, click on the container you want to upgrade.
4. Click on the **Version Config** tab.
5. Enter the new version in the **Version** textfield and click **Upgrade**.

10.5.3. Managing Multiple Containers

You can create and provision multiple containers on your Realtime Decision Server.

Select your server in the **REMOTE SERVERS** section to view all the containers on your server and their status.

Figure 10.2. Managing Multiple Containers



CHAPTER 11. REST API

Representational State Transfer (REST) is a style of software architecture of distributed systems (applications). It allows for a highly abstract client-server communication: clients initiate requests to servers to a particular URL with parameters if needed and servers process the requests and return appropriate responses based on the requested URL. The requests and responses are built around the transfer of representations of resources. A resource can be any coherent and meaningful concept that may be addressed (such as a repository, a Process, a Rule, etc.).

Red Hat JBoss BPM Suite and Red Hat JBoss BRMS provide REST API for individual application components. The REST API implementations differ slightly:

- Knowledge Store (Artifact Repository) REST API calls are calls to the static data (definitions) and are asynchronous, that is, they continue running after the call as a job. These calls return a job ID, which can be used after the REST API call was performed to request the job status and verify whether the job finished successfully. Parameters of these calls are provided in the form of JSON entities.
  The following two API's are only available in Red Hat JBoss BPM Suite.

- Deployment REST API calls are asynchronous or synchronous, depending on the operation performed. These calls perform actions on the deployments or retrieve information about one ore more deployments.

- Runtime REST API calls are calls to the Execution Server and to the Process Execution Engine, Task Execution Engine, and Business Rule Engine. They are synchronous and return the requested data as JAXB objects.

All REST API calls use the following URL with the request body:
`http://SERVER_ADDRESS:PORT/business-central/rest/REQUEST_BODY`

CALLS ON RESOURCES NOT SUPPORTED

Note that it is not possible to issue REST API calls over project resources, such as, rules files, work item definitions, process definition files, etc. are not supported. Perform operation over such files with Git and its REST API directly.

11.1. KNOWLEDGE STORE REST API

REST API calls to Knowledge Store allow you to manage the Knowledge Store content and manipulate the static data in the repositories of the Knowledge Store.

The calls are asynchronous; that is, they continue their execution after the call was performed as a job. All **`POST`** and **`DELETE`** return details of the request as a well as a job id that can be used to request the job status and verify whether the job finished successfully. The **`GET`** operations return information about repositories, projects and organizational units.

Parameters and results of these calls are provided in the form of JSON entities.

11.1.1. Job calls

Most Knowledge Store REST calls return a job ID after it is sent. This is necessary as the calls are asynchronous and you need to be able to reference the job to check its status as it goes through its lifecycle. During its lifecycle, a job can have the following statuses:

- ACCEPTED: the job was accepted and is being processed.
- BAD_REQUEST: the request was not accepted as it contained incorrect content.
- RESOURCE_NOT_EXIST: the requested resource (path) does not exist.
- DUPLICATE_RESOURCE: the resource already exists.
- SERVER_ERROR: an error on the server occurred.
- SUCCESS: the job finished successfully.
- FAIL: the job failed.
- APPROVED: the job was approved.
- DENIED: the job was denied.
- GONE: the job ID could not be found.
  A job can be GONE in the following cases:
  - The job was explicitly removed.
  - The job finished and has been deleted from the status cache (the job is removed from status cache after the cache has reached its maximum capacity).
  - The job never existed.

The following **`job`** calls are provided:

[GET] /jobs/{jobID}

returns the job status - [GET]

> **Example 11.1. Response of the job call on a repository clone request**
>
> ```
> "{"status":"SUCCESS","jodId":"1377770574783-27","result":"Alias:
> testInstallAndDeployProject, Scheme: git, Uri:
> git://testInstallAndDeployProject","lastModified":1377770578194,"detaile
> dResult":null}"
> ```

[DELETE] /jobs/{jobID}

removes the job - [DELETE]

11.1.2. Repository calls

Repository calls are calls to the Knowledge Store that allow you to manage its Git repositories and their projects.

The following **`repositories`** calls are provided:

[GET] /repositories

This returns a list of the repositories in the Knowledge Store as a JSON entity - [GET]

> **Example 11.2. Response of the repositories call**
>
> _

```
[{"name":"brms-assets","description":"generic
assets","userName":null,"password":null,"requestType":null,"gitURL":"
git://brms-assets"},{"name":"loanProject","description":"Loan
processes and
rules","userName":null,"password":null,"requestType":null,"gitURL":"g
it://loansProject"}]
```

[GET] /repositories/{repositoryName}

This returns information on a specific repository - [GET]

[DELETE] /repositories/{repositoryName}

This deletes the repository - [DELETE]

[POST] /repositories/

This creates or clones the repository defined by the JSON entity - [POST]

Example 11.3. JSON entity with repository details of a repository to be cloned

```
{"name":"myClonedRepository", "description":"", "userName":"",
"password":"", "requestType":"clone", "gitURL":"git://localhost/example-
repository"}
```

[GET] /repositories/{repositoryName}/projects/

This returns a list of the projects in a specific repository as a JSON entity - [POST]

Example 11.4. JSON entity with details of existing projects

```
[ {
  "name" : "my-project-name",
  "description" : "Project to illustrate REST output",
  "groupId" : "com.acme",
  "version" : "1.0"
}, {
  "name" : "yet-another-project-name",
  "description" : "Yet Another Project to illustrate REST output",
  "groupId" : "com.acme",
  "version" : "2.2.1"
} ]
```

[POST] /repositories/{repositoryName}/projects/

This creates a project in the repository - [POST]

Example 11.5. Request body that defines the project to be created

```
"{"name":"myProject","description": "my project"}"
```

[DELETE] /repositories/{repositoryName}/projects/

This deletes the project in the repository - [DELETE]

Example 11.6. Request body that defines the project to be deleted

```
"{"name":"myProject","description": "my project"}"
```

11.1.3. Organizational unit calls

Organizational unit calls are calls to the Knowledge Store that allow you to manage its organizational units.

The following **`organizationalUnits`** calls are provided:

[GET] /organizationalunits/

This returns a list of all the organizational units - [GET].

Example 11.7. Organizational unit list in JSON

```
[ {
  "name" : "EmployeeWage",
  "description" : null,
  "owner" : "Employee",
  "defaultGroupId" : "org.bpms",
  "repositories" : [ "EmployeeRepo", "OtherRepo" ]
}, {
  "name" : "OrgUnitName",
  "description" : null,
  "owner" : "OrgUnitOwner",
  "defaultGroupId" : "org.group.id",
  "repositories" : [ "repository-name-1", "repository-name-2" ]
} ]
```

[GET] /organizationalunits/{organizationalUnitName}

This returns a JSON entity with info about a specific organizational unit - [GET].

[POST] /organizationalunits/

This creates an organizational unit in the Knowledge Store - [POST]. The organizational unit is defined as a JSON entity. This consumes an **`OrganizationalUnit`** instance and returns a **`CreateOrganizationalUnitRequest`** instance.

Example 11.8. Organizational unit in JSON

```
{
  "name":"testgroup",
  "description":"",
  "owner":"tester",
  "repositories":["testGroupRepository"]
}
```

[POST] /organizationalunits/{organizationalUnitName}

This *updates* the details of an existing organizational unit - [POST].
Both the **`name`** and **`owner`** fields in the consumed **`UpdateOrganizationalUnit`** instance can be left empty. Both the **`description`** field and the repository association can *not* be updated via this operation.

Example 11.9. Update organizational unit input in JSON

```
{
  "owner" : "NewOwner",
  "defaultGroupId" : "org.new.default.group.id"
}
```

[DELETE] /organizationalunits/{organizationalUnitName}

This deletes an organizational unit - [GET].

[POST] /organizationalunits/{organizationalUnitName}/repositories/{repositoryName}

This adds the repository to the organizational unit - [POST].

[DELETE] /organizationalunits/{organizationalUnitName}/repositories/{repositoryName}

This removes a repository from the organizational unit - [POST].

11.1.4. Maven calls

Maven calls are calls to a Project in the Knowledge Store that allow you to compile and deploy the Project resources.

The following **`maven`** calls are provided below:

[POST] /repositories/{repositoryName}/projects/{projectName}/maven/compile/

This compiles the project (equivalent to **`mvn compile`**) - [POST]. It consumes a **`BuildConfig`** instance, which must be supplied but is not needed for the operation and may be left blank. It also returns a **`CompileProjectRequest`** instance.

[POST] /repositories/{repositoryName}/projects/{projectName}/maven/install/

This installs the project (equivalent to **`mvn install`**) - [POST]. It consumes a **`BuildConfig`** instance, which must be supplied but is not needed for the operation and may be left blank. It also returns a **`InstallProjectRequest`** instance.

[POST] /repositories/{repositoryName}/projects/{projectName}/maven/test/

This compiles and runs the tests - [POST]. It consumes a **`BuildConfig`** instance and returns a **`TestProjectRequest`** instance.

[POST] /repositories/{repositoryName}/projects/{projectName}/maven/deploy/

This deploys the project (equivalent to mvn deploy) - [POST]. It consumes a **`BuildConfig`** instance, which must be supplied but is not needed for the operation and may be left blank. It also returns a **`DeployProjectRequest`** instance.

11.2. REST SUMMARY

The URL templates in the table below are relative to the following URL:

- **http://server:port/business-central/rest**

Table 11.1. Knowledge Store REST calls

URL Template	Type	Description
/jobs/{jobID}	GET	return the job status
/jobs/{jobID}	DELETE	remove the job
/organizationalunits	GET	return a list of organizational units
/organizationalunits	POST	create an organizational unit in the Knowledge Store described by the JSON **`OrganizationalUnit`** entity
/organizationalunits/{organizationalUnitName}/repositories/{repositoryName}	POST	add a repository to an organizational unit
/repositories/	POST	add the repository to the organizational unit described by the JSON **`RepositoryReqest`** entity
/repositories	GET	return the repositories in the Knowledge Store
/repositories/{repositoryName}	DELETE	remove the repository from the Knowledge Store
/repositories/	POST	create or clone the repository defined by the JSON **`RepositoryRequest`** entity
/repositories/{repositoryName}/projects/	POST	create the project defined by the JSON entity in the repository
/repositories/{repositoryName}/projects/{projectName}/maven/compile/	POST	compile the project
/repositories/{repositoryName}/projects/{projectName}/maven/install	POST	install the project
/repositories/{repositoryName}/projects/{projectName}/maven/test/	POST	compile the project and run tests as part of compilation
/repositories/{repositoryName}/projects/{projectName}/maven/deploy/	POST	deploy the project

APPENDIX A. REVISION HISTORY

Note that revision numbers relate to the edition of this manual, not to version numbers of Red Hat JBoss BRMSBPM Suite.

Revision 6.3.0-17 **Mon Mar 20 2017** **Tomas Radej**
Rebuilt.

Revision 6.3.0-16 **Wed Feb 22 2017** **Tomas Radej**
Rebuilt.

Revision 6.3.0-15 **Fri Dec 23 2016** **Tomas Radej**
Rebuilt.

Revision 6.3.0-14 **Mon Nov 28 2016** **Tomas Radej**
Rebuilt.

Revision 6.3.0-13 **Wed Oct 5 2016** **Tomas Radej**
Rebuilt.

Revision 6.3.0-12 **Mon Oct 3 2016** **Tomas Radej**
Built for release 6.3.3.

Revision 6.3.0-11 **Thu Sep 15 2016** **Tomas Radej**
Rebuilt.

Revision 6.3.0-10 **Thu Sep 15 2016** **Tomas Radej**
Published the AsciiDoc version of the docs.

Revision 6.3.0-7 **Thu Jul 14 2016** **Tomas Radej**
Updated documentation with release 6.3.1.

Revision 6.3.0-6 **Thu Jun 2 2016** **Marek Czernek**
Releasing the newest documentation.

Revision 6.3.0-5 **Thu May 5 2016** **Tomas Radej**
Built with live links.

Revision 6.3.0-4 **Thu May 5 2016** **Tomas Radej**
Bootstrapping links.

Revision 6.3.0-3 **Thu Apr 28 2016** **Tomas Radej**
All books rebuilt.

Revision 6.3.0-2 **Thu Apr 28 2016** **Tomas Radej**
All books rebuilt.

Revision 6.3.0-1 **Thu Apr 28 2016** **Tomas Radej**
Initial build for release 6.3.0 of JBoss BPM SuiteJBoss BRMS.