TIBCO ActiveMatrix BusinessWorks™ Plug-in for OSIsoft PI System User's Guide

Software Release 6.1
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Important Information

Contents

TIBCO Documentation and Support Services

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Product-Specific Documentation

Documentation for TIBCO products is not bundled with the software. Instead, it is available on the TIBCO Documentation site at https://docs.tibco.com/products/tibco-activematrix-businessworks-plug-in-for-osisoft-pi-system. To directly access documentation for this product, double-click the following file:

TIBCO_HOME/release_notes/TIB_bwpluginpi_*version*_docinfo.html

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The following documents for this product can be found on the TIBCO Documentation site:

- *TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System Installation*
- *TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System User's Guide*
- *TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System Release Notes*

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Product Overview

TIBCO ActiveMatrix BusinessWorks™ Plug-in for OSIsoft PI System supports data exchange between the PI server and TIBCO ActiveMatrix BusinessWorks™. It offers query capabilities using RPC and JDBC and publish capabilities from the PI server.

TIBCO ActiveMatrix BusinessWorks is a leading integration platform that can integrate a wide variety of technologies and systems within enterprises and on cloud. TIBCO ActiveMatrix BusinessWorks includes an Eclipse-based graphical user interface (GUI) provided by TIBCO Business Studio™ for design, testing, and deployment. To familiarize yourself with TIBCO ActiveMatrix BusinessWorks, see the TIBCO ActiveMatrix BusinessWorks documentation.

TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System plugs into TIBCO ActiveMatrix BusinessWorks and adds an OSIsoft PI System palette into the palette library of TIBCO Business Studio. For more information, see OSIsoft PI System Palette.

With this plug-in, you can:

- Create new tags into the PI server.
- Modify the attributes of existing tags.
- Retrieve tag definitions.
- Retrieve or set tag values, including the latest tag value, the archival tag value, and the historical tag values.
- Monitor the changes of the tag values.

Regarding how to use the plug-in, see Getting Started.

Getting Started

This tutorial is designed for the beginners who want to use TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System in TIBCO Business Studio.

All the operations are performed in TIBCO Business Studio. See TIBCO Business Studio Overview to get familiar with TIBCO Business Studio.

A basic procedure of using TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System includes:

1. Creating a Project
2. Creating an OSIsoft PI System Connection
3. Configuring a Process
4. Testing a Process
5. Deploying an Application

Creating a Project

The first task using the plug-in is creating a project. After creating a project, you can add resources and processes.

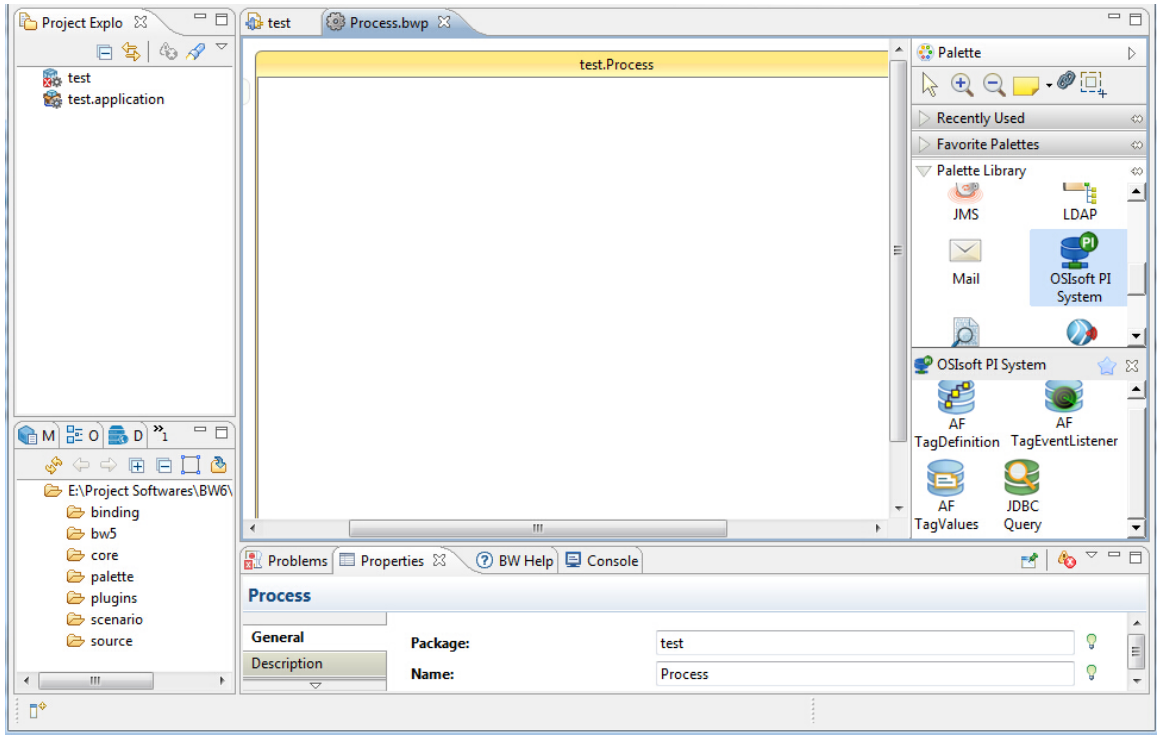
An Eclipse project is an application module configured for TIBCO ActiveMatrix BusinessWorks. An application module is the smallest unit of resources that is named, versioned, and packaged as part of an application.

Procedure

1. Start TIBCO Business Studio using one of the following ways:
   - On Microsoft Windows: click **Start** > **All Programs** > **TIBCO** > *TIBCO_HOME* > **TIBCO Business Studio** *version_number* > **Studio for Designers**.
   - On Linux: run the TIBCO Business Studio executable file located in the *TIBCO_HOME*`/studio/`*version_number*`/eclipse` directory.
2. From the menu, click **File** > **New** > **BusinessWorks Resources** to open the BusinessWorks Resource Wizard.
3. In the "Select a wizard" dialog, click **BusinessWorks Application Module** and click **Next** to open the New BusinessWorks Application Module wizard.
4. In the Project dialog, configure the project that you want to create:
   a) In the **Project name** field, enter a project name.
   b) By default, the created project is located in the workspace currently in use. If you do not want to use the default location for the project, clear the **Use default location** check box and click **Browse** to select a new location.
   c) Use the default version of the application module, or enter a new version in the **Version** field.
   d) Keep the **Create empty process** and **Create Application** check boxes selected to automatically create an empty process and an application when creating the project.
   e) If you want to create a Java module, select the **Use Java configuration** check box.
   A Java module provides the Java tooling capabilities.
   f) Click **Finish** to create the project.

Result

The project with the specified settings is displayed in the Project Explorer view.



Creating an OSIsoft PI System Connection

After creating a project, add an OSIsoft PI System Connection shared resource to create a connection between the plug-in and the PI server.

According to the type of the activity, create one of the following connections:

- For the JDBC Query activity, create an OSIsoft PI System JDBC connection.
- For the AF type activities, that is the AF TagDefinition, AF TagEventListener, and AF TagValues activities, create an OSIsoft PI System AF connection.

The OSIsoft PI System AF Connection shared resource is only available on Windows.

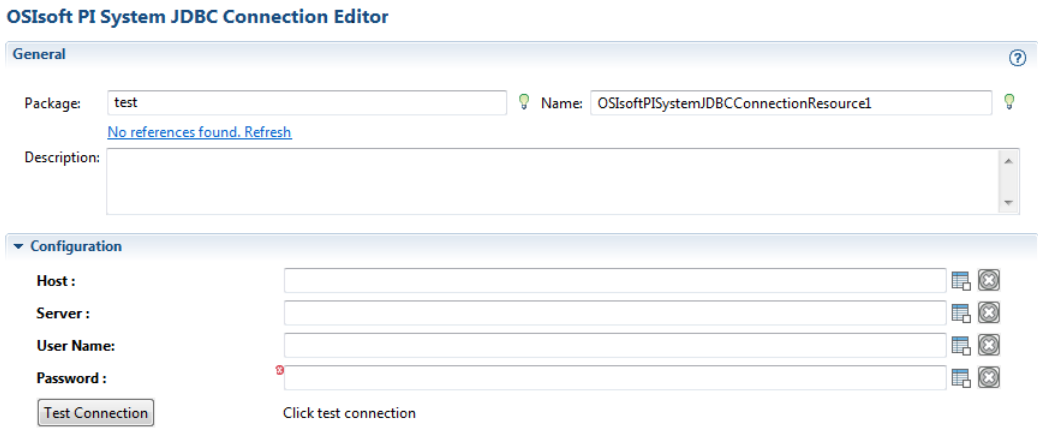
In this tutorial, the JDBC Query activity is used as the example, therefore, an OSIsoft PI System JDBC connection must be created. The OSIsoft PI System AF connection can be created in the same way.

Prerequisites

Ensure that you have created a project. For more information, see Creating a Project.

Procedure

1. Expand the project in the Project Explorer view.
2. Right-click the **Resources** folder and click **New** > **OSIsoft PI System JDBC Connection** to open the OSIsoft PI System JDBC Connection Resource dialog.
3. Specify the resource folder, package name, and resource name of the connection if you do not want to use the default configurations. Click **Finish** to open **OSIsoft PI System JDBC Connection Editor**.



4. In the **Configuration** panel, configure the shared resource.

   For detailed information about the configuration parameters, see OSIsoft PI System JDBC Connection.

5. Click **Test Connection** to validate the connection.

Configuring a Process

After creating a project, an empty process is created. You can add activities to the empty process to complete a task.

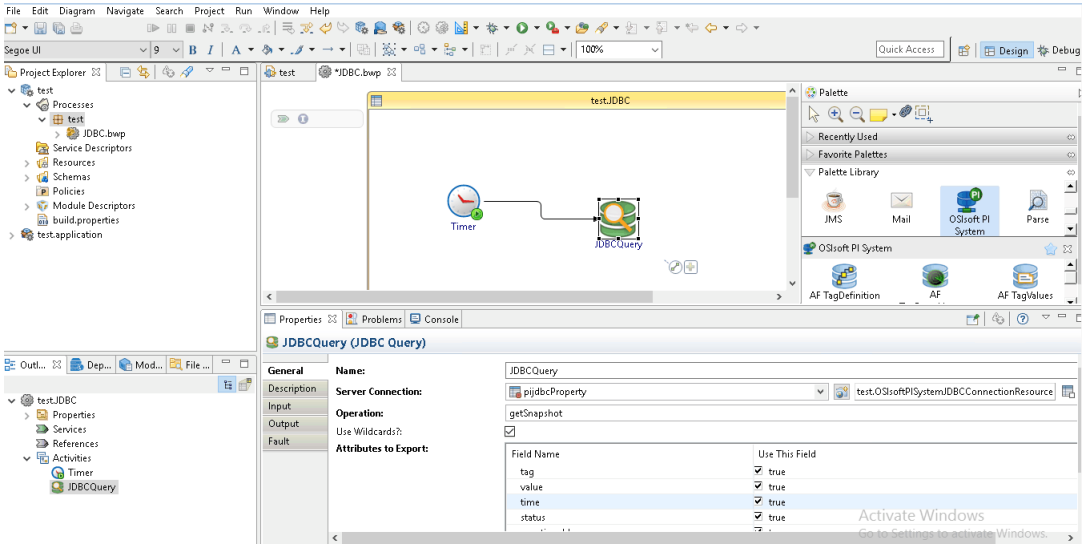
For example, use the JDBC Query activity to get the snapshot tag value, that is the tag value with the most recent timestamp.

Prerequisites

Ensure that you have created an empty process and an OSIsoft PI System JDBC connection. For more information, see Creating a Project and Creating an OSIsoft PI System Connection. If you have not created an empty process when creating a project, see *TIBCO ActiveMatrix BusinessWorks Application Development* for more information about how to create a process.

Procedure

1. In the Project Explorer view, click the created project and open the empty process from the **Processes** folder.
2. Select an activity from the Palette view and drop it in the Process editor.
   For example, select and drop the Timer activity from the General Activities palette and the JDBC Query activity from the OSIsoft PI System palette.



3. Drag the icon to create a transition between the added activities.
4. Configure the added activities.
   For more information about the configuration parameters, see OSIsoft PI System Palette.
5. Click **File** > **Save** to save the project.

Testing a Process

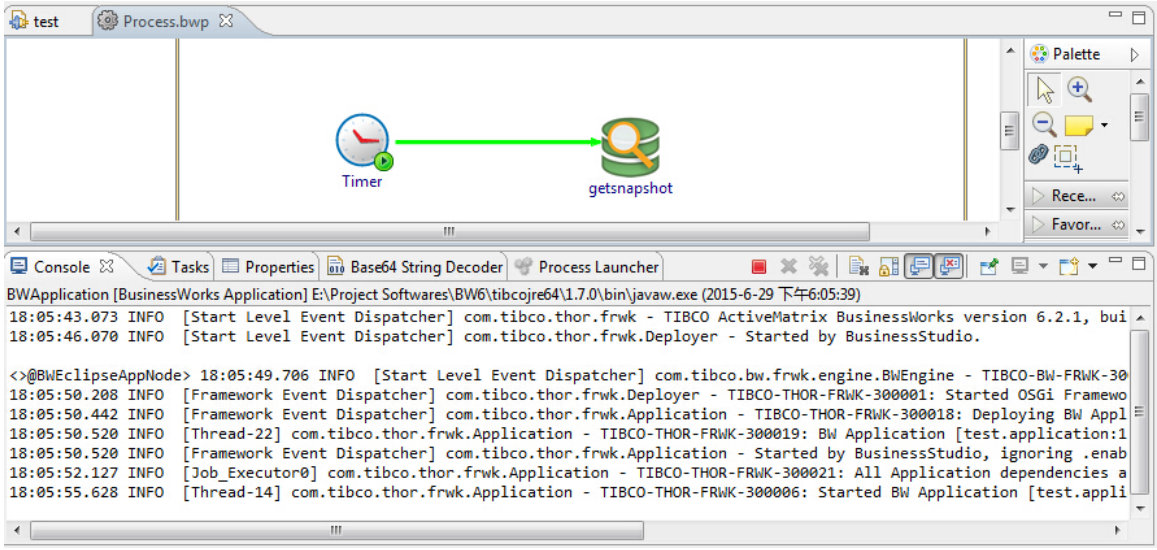
After configuring a process, you can test the process to check if the process completes your task.

Prerequisites

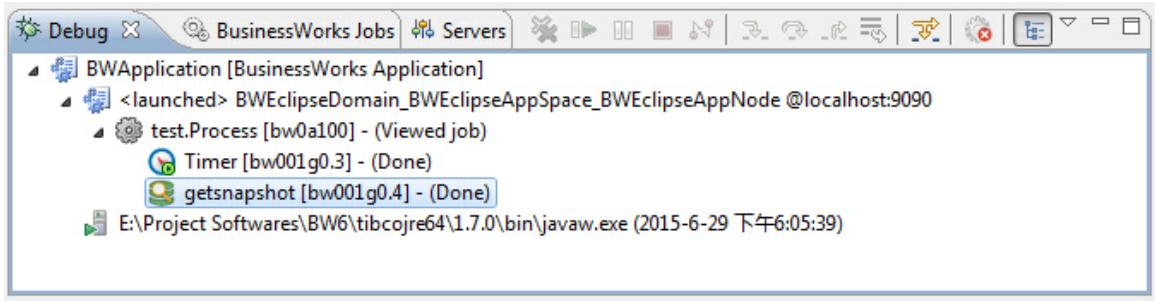
Ensure that you have configured a process. For more information, see Configuring a Process.

Procedure

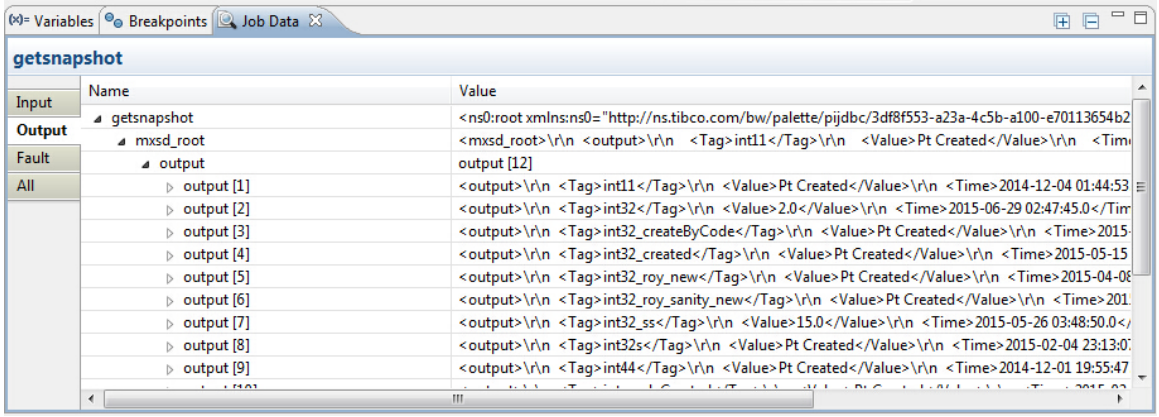
1. On the toolbar, click **Debug** > **Debug Configurations**.
2. Click **BusinessWorks Application** > **BWApplication** in the left panel.
   By default, all the applications in the current workspace are selected in the **Applications** tab. Ensure that only the application you want to debug is selected in the **Applications** tab in the right panel.
3. Click **Debug** to test the process in the selected application.
   TIBCO Business Studio changes to the Debug perspective. The debug information is displayed in the Console view.



4. In the **Debug** tab, expand the running process and click an activity.



5. In the upper-right corner, click the **Job Data** tab, and then click the **Output** tab to check the activity output.



Deploying an Application

After testing, if the configured process works as expected, you can deploy the application that contains the configured process into a runtime environment, and then use the **`bwadmin`** utility to manage the deployed application.

Before deploying an application, you must generate an application archive, which is an enterprise archive (EAR) file that is created in TIBCO Business Studio. For more information, see TIBCO Business Studio Overview.

Deploying an application involves the following tasks:

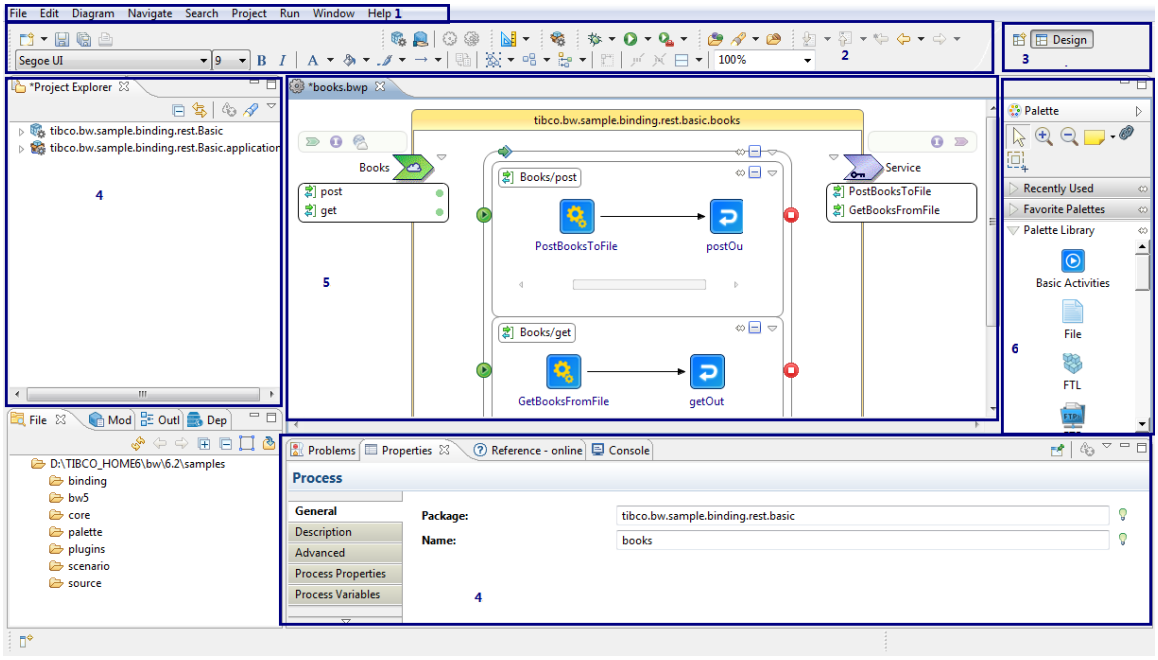
1. Uploading an application archive
2. Deploying an application archive
3. Starting an application

For more information about how to deploy an application, see *TIBCO ActiveMatrix BusinessWorks Administration*.

TIBCO Business Studio Overview

TIBCO Business Studio is an Eclipse-based integration development environment that is used to design, develop, and test ActiveMatrix BusinessWorks applications.

TIBCO Business Studio provides a workbench in which you can create, manage, and navigate resources in your workspace. A *workspace* is the central location on your machine where all data files are stored.



The workbench consists of:

1. **Menu**: contains menu items such as File, Edit, Diagram, Navigate, Search, Project, Run, Window, and Help.
2. **Toolbar**: contains buttons for frequently used commands such as New , Save , Enable/Disable Business Studio capabilities , Create a new BusinessWorks Application Module , Create a new BusinessWorks Shared Module , Debug , Run , and so on.
3. **Perspective**: contains an initial set and layout of views that are required to perform a certain task. TIBCO Business Studio launches the Modeling perspective by default. You can change the perspective from the menu **Window** > **Open Perspective** > ***Perspective_Name***.
4. **View**: displays resources. For example, the Project Explorer view displays the ActiveMatrix BusinessWorks applications, modules, and other resources in your workspace, while the Properties view displays the properties for the selected resource. You can open a view from the menu **Window** > **Show View** > ***View_Name***.
5. **Editor**: provides a canvas to configure, edit, or browse a resource. Double-click a resource in a view to open the appropriate editor for the selected resource. For example, double-click an ActiveMatrix BusinessWorks process (`MortgageAppConsumer.bwp`) in the Project Explorer view to open the process in the editor.

6. **Palette**: contains a set of widgets and a palette library. A *palette* groups activities that perform similar tasks and provides quick access to activities when configuring a process.

OSIsoft PI System Connection

This plug-in provides two shared resources that you can use to create a connection to the PI server.

There are two types of connections in this plug-in, OSIsoft PI System JDBC connection, which is used for the JDBC Query activity and OSIsoft PI System AF connection, which is used for the AF activities.

OSIsoft PI System AF Connection

With the OSIsoft PI System AF Connection shared resource, you can create a connection between the plug-in and a PI AF server. This shared resource is used for the AF activities, including the AF TagDefinition, AF TagEventListener, and AF TagValues activities.

General

In the **General** panel of OSIsoft PI System AF Connection Editor, you can specify the package that stores the OSIsoft PI System AF Connection shared resource, and the name and description of the shared resource.

The following table lists the fields in the **General** panel:

Field	Module Property?	Description
Package	No	The name of the package where the new shared resource is added.
Name	No	The name to be displayed as the label for the shared resource in the process.
Description	No	A short description for the shared resource.

Configuration

In the **Configuration** panel of OSIsoft PI System AF Connection Editor, you can specify information of the PI AF server that the plug-in connects to.

The following table lists the fields in the **Configuration** panel:

Field	Module Property?	Description
Server Name	Yes	The IP address or name of the machine where the PI server is installed.
Security Type	No	The authentication mode used for connecting to the PI server: • **User Name**: the user name and password are required for connecting to the PI server. • **PI Trust**: you can log on to the PI server automatically without entering the user name and password.

Field	Module Property?	Description
User Name	Yes	The user name of the PI user used to connect to the PI server. This field is only available when you select **User Name** in the **Security Type** list.
Password	Yes	The password used to connect to the PI server. This field is only available when you select **User Name** in the **Security Type** list.
Server Role	Yes	The role of the server you want to use when connecting to the PI server. Server role is relevant in high-availability environments with two or more replicated servers. Supported server roles in this field include `Any`, `PreferPrimary`, and `RequirePrimary`. For more information, see the PI SDK documentation.
Test PI Point	Yes	The name of an existing tag on the PI server. This point is used to check the connectivity to the PI server. The default value in this field is `SINUSOID`. If you use a customized test point, make sure that the connection to the PI server is successful. Otherwise, the runtime reconnection to the PI server always fails.
Maximum Number of Reconnect Attempts	Yes	The maximum number of attempts for the plug-in to reconnect to the PI server when the server is unavailable. The default value is `-1`.
Number of Reconnect Attempts Before Suspending Impacted Services(s)	Yes	The total number of automatic reconnection attempts. The default value is `5`, which indicates that there is no restriction on the times of reconnection.
Interval Between Reconnect Attempts(milliseconds)	Yes	The interval between detected connection failure and automatic reconnection in milliseconds. The default value is `1000`.
Test Connection	No	When you finish the configuration, click this button to test whether the parameters are set correctly.

OSIsoft PI System JDBC Connection

With the OSIsoft PI System JDBC Connection shared resource, you can create a connection between the plug-in and the PI server. This shared resource is used for the JDBC Query activity.

General

In the **General** panel of OSIsoft PI System JDBC Connection Editor, you can specify the package that stores the OSIsoft PI System JDBC Connection shared resource, and the name and description of the shared resource.

The following table lists the fields in the **General** panel:

Field	Module Property?	Description
Package	No	The name of the package where the new shared resource is added.
Name	No	The name to be displayed as the label for the shared resource in the process.
Description	No	A short description of the shared resource.

Configuration

In the **Configuration** panel of OSIsoft PI System JDBC Connection Editor, you can specify information of the PI JDBC server that the plug-in connects to.

The following table lists the fields in the **Configuration** panel:

Field	Module Property?	Description
Host	Yes	The IP address or name of the machine where the PI server is installed.
Server	Yes	The server selected for connection.
User Name	Yes	The user name used to log on to the PI server. If the host machine belongs to a certain domain, you can enter *`Domain/User Name`* in this field.
Password	Yes	The password required for connection.
Test Connection	No	When you finish the configuration, click this button to test whether the parameters are set correctly.

OSIsoft PI System Palette

A palette groups the activities that connect to the same external applications. Once TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System is installed, an **OSIsoft PI System** palette is added into the palette library.

The **OSIsoft PI System** palette contains the following activities:

- AF TagDefinition: retrieves tag definitions from the PI server, modifies tag definitions, and creates new tags into the PI server.
- AF TagEventListener: listens on tag updates and then fetches the updated entries.
- AF TagValues: retrieves tag values, including the latest value, historical values, and the archival value, and it sets tag values.
- JDBC Query: gets tag definitions and retrieves tag values, including the latest value and historical values.

The AF type activities are only available on Windows.

AF TagDefinition

By using the AF TagDefinition activity, you can retrieve tag definitions from the PI server, modify tag definitions, and create new tags into the PI server.

General

In the **General** tab, you can specify the name of the activity in the process, establish a connection to the PI AF server, and select what type of operation you want to perform.

The following table lists the fields in the **General** tab of the AF TagDefinition activity:

Field	Module Property?	Description
Name	No	A unique name of the activity in a process.
Server Connection	Yes	The PI AF shared resource selected to connect to a PI AF server. Click the  icon to select an OSIsoft PI System AF connection resource. If no matching OSIsoft PI System AF connection resource is found, click **Create Shared Resource** to create one.
Operation	No	The type of operation you want to perform: • **getTagDefinitions**: retrieves tag definitions. • **upsertTags**: creates or modifies tag definitions.

Description

In the **Description** tab, you can type a short description for the AF TagDefinition activity.

Input

In the **Input** tab, you can specify the tag that you want to retrieve, modify, or create for the AF TagDefinition activity.

Input elements in this tab are different depending on the operation you select in the **General** tab:

- If you select the **getTagDefinitions** operation, see the Input items for getTagDefinitions table for descriptions of the input items.
- If you select the **upsertTags** operation, see the Input items for upsertTags table for descriptions of the input items.

Input items for getTagDefinitions

The following table provides descriptions of the input items for the getTagDefinitions operation.

Input Item	Data Type	Required	Description
`requestHeader`	Complex	No	The request message header. For descriptions of all the attributes in this element, see Attributes in requestHeader.
`filterExpression`	String	Yes	The expression used for filtering the returned tag definitions. The expression format must correspond with the method you specify in the **useMethod** element. For example, to get all tags starting with *a*: • If the **useMethod** element is set to `useGetPoints`, type `"a*"` in this field. • If the **useMethod** element is set to `useGetPointsSql`, type `"tag:a*"` in this field.
`useMethod`	String	No	The filtering method used to evaluate the filtering expression in the **filterExpression** element. Enter one of the following methods in this field: • `useGetPoints` (default): the method that uses PI server specific syntax. • `useGetPointsSql`: the method that uses SQL-like syntax.

Input items for upsertTags

The following table provides descriptions of the input items for the upsertTags operation.

Input Item	Data Type	Required	Description
`requestHeader`	Complex	No	The request message header. For descriptions of all the attributes in this element, see Attributes in requestHeader.
`tagList`	Complex	Yes	The list of tag definitions that you want to create or modify.

Input Item	Data Type	Required	Description
`whenExistsModify`	Boolean	No	The parameter that specifies the tag definitions to be either created or modified. • If it is set to `false`, the tag definitions are to be created. • If it is set to `true`, the tag definitions are to be modified. By default, the value in this field is `false`.

Output

In the **Output** tab of the AF TagDefinition activity, you can find the results corresponding to your inputs.

The output elements in this tab are different depending on the operation name you select in the **General** tab.

All the time is in UTC time zone.

The following table lists the output items for the **getTagDefinitions** and **upsertTags** operations:

Output Item	Data Type	Description
If you select the **getTagDefinitions** operation, the following output items are available:		
`responseHeader`	Complex	The response message header.
`tagDefinitionList`	Complex	The list of tag definitions that match the provided filtering expression returned by the PI server. For descriptions of all the attributes in this item, see Attributes in tagDefinitionList.
If you select the **upsertTags** operation, the following output items are available:		
`responseHeader`	Complex	The response message header.
`failureList`	Complex	A list of tags that are operated in the wrong way.
`pointsCreated`	Integer	The number of tags that are successfully created.
`pointsModified`	Integer	The number of tags that are successfully modified.

Fault

In the **Fault** tab, you can find the error messages and error codes of the AF TagDefinition activity. For more information about errors, see Error Codes.

The following table lists the error schema elements in the **Fault** tab:

Element Name	Data Type	Description
msg	String	Displays the error message.
msgCode	String	Displays the error code.

Attributes in requestHeader

In this section, you can find the descriptions of all the attributes for the **requestHeader** item in the **Input** tab.

The following table provides the descriptions of all the attributes in the **requestHeader** item:

Attribute Name	Data Type	Required	Description
consumer	String	No	The identifier of the message user.
provider	String	No	The identifier of the message provider.
timestamp	String	No	The date and time when the message is generated.
messageId	String	No	The globally unique identifier of the message.
correlationId	String	No	The correlation identifier that can be used for correlating multiple messages.

Attributes in tagDefinitionList

In this section, you can find the descriptions of all the attributes for the **tagDefinitionList** item in the **Output** tab.

The **tagDefinitionList** item is displayed in the **Output** tab only when you choose **getTagDefinitions** from the **Operation** list in the **General** tab.

The following table provides the descriptions of all the attributes in the **tagDefinitionList** item:

Attribute Name	Data Type	Description
pointName	String	The name of the tag on the PI server.
descriptor	String	The description of the PI tag.
piServerName	String	The name of the PI server that records the tag.
pointClass	String	The attribute that specifies point class from the point classes that belong to the PI server.
pointType	String	The attribute that specifies the data type for the values that a point stores. Supported point types include: Digital, Timestamp, Float64, Float32, Float16, Int32, Int16, String, and Blob.
pointSource	String	The attribute that identifies the source of data for a PI point.

Attribute Name	Data Type	Description
changeDate	String	The last time when the PI point was changed.
creationDate	String	The time when the PI point was created.
digitalSet	String	The name of the digital set. This attribute is only relevant when the pointType attribute is Digital.
engineeringUnits	String	The default unit of measurement for the PI point.
extendedDescription	String	Optional extended description for the PI point.
sourceTag	String	Reference to another PI point. Data stream of this PI point is used as the source for the given PI point.
displayDigits	String	The attribute that determines the display precision of PI point values.
archiving	String	The attribute that enables or disables values archiving. Supported values are 0 and 1.
scan	String	The attribute that enables or disables interface scanning. Supported values are 0 and 1.
compressing	String	The attribute that determines whether snapshot events are selected to be sent to the archive file for storage. Supported values are 0 and 1.
zero	String	The lowest possible value of a PI point.
span	String	The range between the maximum and minimum values for a point. The sum of zero and span determines the highest possible value.
excdev	String	Exception deviation, the set of values that define a deadband used for exception reporting. If this attribute is used, the excdevpercent attribute is recalculated.
excdevpercent	String	Percentage of exception deviation. If this attribute is used, the excdev attribute is recalculated.
compdev	String	Compression deviation, the compression algorithm used to reduce the data flow from the interfaces to the PI server. If this attribute is used, the compdevpercent attribute is recalculated.

Attribute Name	Data Type	Description
`compdevpercent`	String	Percentage of compression deviation. If this attribute is used, the `compdev` attribute is recalculated.

AF TagEventListener

The AF TagEventListener activity publishes notification messages each time values of the tags that you listen to are changed. Therefore, by using this activity, you can listen to tag updates and fetch the changed entries.

General

In the **General** tab, you can specify the name of the activity in the process, establish a connection to the PI AF server, select the tags to listen to, and define how often the tag updates are to be checked.

The following table lists the fields in the **General** tab of the AF TagEventListener activity:

Field	Module Property?	Description
Name	No	A unique name of the activity in a process.
Server Connection	Yes	The PI AF shared resource selected to connect to a PI AF server. Click the  icon to select an OSIsoft PI System AF connection resource. If no matching OSIsoft PI System AF connection resource is found, click **Create Shared Resource** to create one.
Polling Interval (milliseconds)	Yes	The polling interval of publishing, which specifies how often in milliseconds the tags in the **Tag List** are checked for value updates.
Tag List	No	The list of tags that you listen to: • **Add**: inserts a new row at the bottom of the list, in which you can type the name of the tag to listen to. • **Remove**: deletes a selected row in the list. When the table is empty, this button is disabled. • **Add Tags From File**: quickly adds multiple tags into the list at a time by loading a `.txt` or `.csv` file encoded in ASCII with one tag name per row. If the tags you listen to do not exist in the PI server, warning messages are displayed in the Console view at run time.

Description

In the **Description** tab, you can type a short description for the AF TagEventListener activity.

Advanced

In the **Advanced** tab, you can specify the object class of the entry that you want to search for.

The following table lists the fields in the **Advanced** tab of the AF TagEventListener activity:

Field	Module Property?	Description
Sequence Key	No	This field contains an XPath expression that specifies the order in which the process runs. Process instances with sequencing keys that have the same value are executed sequentially in the order in which the process instances were created.
Custom Job Id	No	This field contains an XPath expression that specifies a custom job ID for the process instance. This ID is displayed in the TIBCO Administrator View Service dialog, and it is also available in the $_processContext process variable.

Conversations

A conversation represents two or more related message exchanges in the same process that are correlated by the BusinessWorks engine. In the **Conversations** tab, you can initiate a conversation by clicking the **Add New Conversation** icon  .

For more information about how to use conversations, see *TIBCO ActiveMatrix BusinessWorks Application Development*.

Output

In the **Output** tab, you can find the published changes of the tag values.

All the time is in UTC time zone.

The changes of the tag values are displayed under the following output items:

Output Item	Data Type	Description
`header`	Complex	The response message header.
`serverName`	String	The name of the PI server that stores the tag.
`tagList`	Complex	The tag value that is changed.

For descriptions of all the attributes in the previous three items, see Attributes in the Output Items.

Attributes in the Output Items

In this section, you can find the descriptions of all the attributes for the **header**, **serverName**, and **tagList** items in the **Output** tab.

The following table provides the descriptions of all the attributes in the **header** item:

Attribute Name	Data Type	Description
`consumer`	String	The identifier of the message user.
`provider`	String	The identifier of the message provider.

Attribute Name	Data Type	Description
`timestamp`	String	The date and time when the message is generated.
`requestMessageId`	String	The globally unique identifier of the request message.
`responseMessageId`	String	The globally unique identifier of the response message.
`correlationId`	String	The correlation identifier that can be used for correlating multiple messages.

The following table provides the descriptions of all the attributes in the **serverName** and **tagList** items:

Attribute Name	Data Type	Description
`serverName`	String	The name of the PI server that stores the tag.
`name`	String	The unique name of the tag.
`value`	String	The tag value returned by the PI server. If the value is not available for any reason, it is set to `N/A`. And it is not relevant for Blob type tags.
`binaryValue`	Binary	The binary value of the tag returned by the PI server. If the value is not available for any reason, it is set to `N/A`. And it is relevant for Blob type tags only.
`timestamp`	String	The date and time when the tag value is generated.
`isGood`	Boolean	The attribute that identifies whether the tag value is valid.

AF TagValues

By using the AF TagValues activity, you can set tag values and get tag values, including the most recent value, the historical values, a specified number of historical values, and the archived value for a specified time.

General

In the **General** tab, you can specify the name of the activity in the process, establish a connection to the PI AF server, select which type of operation you want to use, and the type of value that you want to retrieve.

The following table lists the fields in the **General** tab of the AF TagValues activity:

Field	Module Property?	Description
Name	No	A unique name of the activity in a process.

Field	Module Property?	Description
Server Connection	Yes	The PI AF shared resource selected to connect to a PI AF server. Click the  icon to select an OSIsoft PI System AF connection resource. If no matching PI AF connection resource is found, click **Create Shared Resource** to create one.
Operation	No	The type of operation you want to perform on the tag values: • **getTagValues**: retrieves tag values. • **setTagValues**: sets tag values.
Value Type	No	The type of value that you want to retrieve for the tag: • **Snapshot**: the value with the most recent timestamp. • **ArcValue**: the archived value with a specified timestamp. • **ValueHistory**: the specified number of historical values if you input a positive integer for the **count** parameter in the **Input** tab, or the historical values within a specified time frame if you input nothing for the **count** parameter in the **Input** tab.  This field is only available when you select **getTagValues** in the **Operation** list.

Description

In the **Description** tab, you can type a short description for the AF TagValues activity.

Input

In the **Input** tab, you can specify the tag that you want to retrieve or set.

Input items in this tab are different depending on the operation name and value type you select in the **General** tab:

- If you select the **getTagValues** operation, depending on the value type you select, different input items are available:

Value Type	Refer To
Snapshot	getTagValues: Snapshot Input Items
ArcValue	getTagValues: ArcValue Input Items
ValueHistory	getTagValues: ValueHistory Input Items

- If you select the **setTagValues** operation, the following input items are available:

Input Item	Data Type	Description
`requestHeader`	Complex	The request message header

Input Item	Data Type	Description
`tagList`	Complex	The list of tags and their attributes to be set

For descriptions of all the attributes in the previous two input items, see setTagValues: Input Items.

Output

In the **Output** tab, you can find the output results of the AF TagValues activity.

All the time is in UTC time zone.

Output items in this tab are different depending on the operation name and value type you select in the **General** tab:

- If you select the **getTagValues** operation, depending on the value type you selected, different output items are displayed:

Value Type	Refer To
Snapshot	getTagValues: Snapshot Output Items
ArcValue	getTagValues: ArcValue Output Items
ValueHistory	getTagValues: ValueHistory Output Items

- If you select the **setTagValues** operation, the following output items are displayed:

Output Item	Data Type	Description
`responseHeader`	Complex	The response message header
`failureList`	Complex	The list of failures
`pointsUpdated`	Integer	The number of tags that are successfully updated

Fault

In the **Fault** tab, you can find the error messages and error codes of the AF TagValues activity. For more information about errors, see Error Codes.

The following table lists the error schema elements in the **Fault** tab:

Element Name	Data Type	Description
`msg`	String	Displays the error message.
`msgCode`	String	Displays the error code.

getTagValues: Input Items

In this section, you can find the descriptions of the input items for the getTagValues operation depending on the value type you select in the **General** tab.

Snapshot

The following table provides the descriptions of the input items for the `Snapshot` type of value:

Input Item	Data Type	Required	Description
`requestHeader`	Complex	No	The request message header.
`tagList`	Complex	Yes	The list of tag names that you want to get values for. You can add multiple tags in this list.
`staleFrom`	String	Yes	The starting time of the stale period.  You have to specify both `staleFrom` and `staleTo`, and the `staleTo` value has to be more recent than the `staleFrom` value.
`staleTo`	String	Yes	The ending time of the stale period.  You have to specify both `staleFrom` and `staleTo`, and the `staleTo` value has to be more recent than the `staleFrom` value.

ArcValue

The following table provides the descriptions of the input items for the `ArcValue` type of value:

Input Item	Data Type	Required	Description
`requestHeader`	Complex	No	The request message header.
`tag`	String	Yes	The name of the tag that you want to get historical values for.
`timeStamp`	String	No	The timestamp of the requested value. If you do not specify the value, `"*"` is filled in this field, which means the current date and time.
`mode`	String	No	The attribute that determines how the value is assigned to the timestamp. Supported modes in this plug-in are `Auto`, `AtOrBefore`, `Before`, `AtOrAfter`, `After`, and `Exact`. If you do not specify a value, `Auto` is filled in this field.

ValueHistory

The following table provides the descriptions of the input items for the `ValueHistory` type of value:

Input Item	Data Type	Required	Description
`requestHeader`	Complex	No	The request message header.
`tag`	String	Yes	The name of the tag that you want to get historical values for.
`startTime`	String	No	The starting time for filtering results. If you do not specify the value, `"*"` is filled in this field, which means the current date and time.
`endTime`	String	No	The end time for filtering results.
`count`	Integer	No	The number of values that are retrieved from the starting time forwards or backwards.
`isForward`	Boolean	No	The attribute that determines the timestamp range for retrieving in relation to the specified `startTime`: • If it is set to `false()`, tag values with timestamps that are less recent than the specified `startTime` are retrieved. The tag value are returned in time descending order. • If it is set to `true()`, tag values with timestamps that are more recent than the specified `startTime` are retrieved. If you do not specify the value, `false()` is filled in this field by default.
`boundaryType`	String	No	The attribute that determines which values are returned in relation to the requested time boundaries. Supported boundary types in this plug-in are `Inside`, `Outside`, and `Interpolated`. If you do not specify the value, `Inside` is filled in this field by default.
`filterExp`	String	No	The PE syntax expression used for filtering historical values. For example, `"'SINUSOID'>70" and "'SINUSOID'<80"`.

In version 6.0.0 of TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System, the input items for the **ValueHistory** type are `requestHeader`, `tag`, `startTime`, `endTime`, `boundaryType` and `filterExp`, the input items for the **ValueHistoryByCount** type are `requestHeader`, `tag`, `startTime`, `count`, `isForward`, `boundaryType` and `filterExp`.

In version 6.1.0 of TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System, the **ValueHistory** type and the **ValueHistoryByCount** type are merged into one type **ValueHistory**, but the input items have the same meanings as in version 6.0.0.

setTagValues: Input Items

In this section, you can find the description of all the input items for the setTagValues operation.

The following table provides the descriptions of the input items for the setTagValues operation:

Input Item	Data Type	Required	Description
Under **requestHeader**, the following input items are available:			
`consumer`	String	No	The identifier of the message user.
`provider`	String	No	The identifier of the message provider.
`timestamp`	String	No	The date and time when the message is generated.
`messageId`	String	No	The globally unique identifier of the message.
`correlationId`	String	No	The correlation identifier that can be used for correlating multiple messages.
Under **tagList**, the following input items are available:			
`name`	String	Yes	The unique name of a tag.
`timestamp`	String	No	The date and time of the tag value.
`mergeType`	String	No	The attribute that indicates how to deal with the duplicated values in the archive file. Supported values in this field are `Replace`, `Insert`, `NoReplace`, `ReplaceOnly`, `InsertNoCompression`, and `Remove`. For more information, see the AFSDK documentation.
`value`	String	Yes	The value of the tag to be set on the PI server.  This value is not relevant for Blob type tags.
`binaryvalue`	Binary	Yes	The binary value of the tag to be set on the PI server.  This value is relevant for Blob type tags only.

getTagValues: Output Items

In this section, you can find the descriptions of the output items for the getTagValues operation depending on the value type you select in the **General** tab.

Snapshot

The following table provides the descriptions of the output items for the Snapshot type of value:

Output Item	Data Type	Description
`responseHeader`	Complex	The response message header.
`failureList`	Complex	A list of tags that are operated in the wrong way. It is used as an output item in bulk tag operations where some of the tag operations succeed and some fail. For descriptions of the attributes in this item, see Attributes in the failureList item.
`tagValueList`	Complex	A list of current tag values stored on the PI server. For descriptions of the attributes in this item, see Attributes in the tagValueList item.

Attributes in the failureList item

Attribute Name	Data Type	Description
`tagName`	String	The name of the tag under which the operation fails.
`errorCode`	String	The unique identification of the error.
`errorDesc`	String	The text description of the error.

Attributes in the tagValueList item

Attribute Name	Data Type	Description
`name`	String	The unique name of the tag name.
`value`	String	The tag value returned from the PI server. If the value is not available for any reason, `N/A` is filled in this field. This value is not relevant for Blob type tags.
`binaryValue`	Binary	The binary value of the tag returned from the PI server. If the value is not available for any reason, `N/A` is filled in this field. This value is only relevant for Blob type tags.
`timestamp`	String	The timestamp of the tag value.

Attribute Name	Data Type	Description
`isGood`	Boolean	The attribute that identifies whether the tag is set to a valid value.
`isStale`	Boolean	The attribute that identifies whether the last tag value change is stale in relation to the stale period you specify in the getValues request. The value is relevant only when the `staleFrom` and `staleTo` values are specified in the getValues request. • If the last tag value change happens within the stale period, `isStale` is set to `true`. • If the last tag value change happens after the `staleTo` value, `isStale` is set to `false`. • If the last tag value change happens before the `staleFrom` value, then the tag is omitted from the response message.

ArcValues

The following table provides the descriptions of the output items for the ArcValue type of value:

Output Item	Data Type	Description
`responseHeader`	Complex	The response message header.
`arcValue`	Complex	A single value associated to the timestamp. For descriptions of the attributes in this element, see Attributes in the arcValue item.

Attributes in the arcValue item

Output Item	Data Type	Description
`value`	String	The archival value of the tag.
`binaryValue`	Binary	The archival binary value of the tag. This value is only relevant to Blob type tags.
`timestamp`	String	The timestamp of the archival value of the tag.

ValueHistory

The following table provides the descriptions of the output items for the ValueHistory type of value:

Output Item	Data Type	Description
`responseHeader`	Complex	The response message header.

Output Item	Data Type	Description
`valueList`	Complex	A list of historical values that match the filtering criteria.

JDBC Query

By using the JDBC Query activity, you can retrieve tag definitions and retrieve the tag value with the most recent timestamp or historical tag values within a specified time range.

The time zone of the data retrieved from the OSIsoft PI Server is the time zone of the OSIsoft PI Server.

General

In the **General** tab, you can specify the name of the activity in the process, establish a connection to the PI JDBC server, select the type of operation you want to perform, specify and export the XSD schema.

The following table lists the fields in the **General** tab of the JDBC Query activity:

Field	Module Property?	Description
Name	No	A unique name of the activity in a process.
Server Connection	Yes	The PI JDBC shared resource selected to connect to a PI JDBC server. Click the  icon to select an OSIsoft PI System JDBC connection resource. If no matching PI JDBC connection resource is found, click **Create Shared Resource** to create one.
Operation	No	The type of operation you want to perform: • **getSnapshot**: gets the snapshot value that has the most recent timestamp. • **getArcvalue**: gets the historical values within a specified time range. • **getTagDefinition**: gets tag definitions.
Use Wildcards	No	The option that determines precise query or fuzzy query will be performed on the PI server according to the tag names you enter in the **Input** tab. • If you select this check box, you can only enter one tag name in the **Input** tab, and then fuzzy query is performed on the PI server. • If you do not select this check box, you can enter multiple tag names in the **Input** tab, and then precise query is performed on the PI server.  This check box is only available for the **getSnapshot** and **getTagDefinition** operations.

Field	Module Property?	Description
Attributes to Export	No	The list of value attributes that you can select to specify the schema for the output data in the **Output** tab. You can also load a customized output schema file for your JDBC activity. For more information, see Customizing JDBC Output Schema.
Export xsd schema	No	After finishing your selection in **Attributes to Export** or loading a customized output schema file, click this button to export the schema which is then displayed in the **Output** tab.

Description

In the **Description** tab, you can type a short description for the JDBC Query activity.

Input

In the **Input** tab, you can specify the tag name, time span, or both for your activity.

The input items are different depending on the operation type you select in the **General** tab:

Input Item	Description
If you select the **getSnapshot** or **getTagDefinition** operation, the following input item is available:	
`TagName`	The name of the tag that you want to retrieve. You can enter multiple tag names by right-clicking **TagName** and then clicking **Duplicate**. But this operation is only applicable when the **Use Wildcards** check box is cleared in the **General** tab.
If you select the **getArcvalue** operation, the following input items are available:	
`TagName`	The name of the tag that you want to retrieve.
`StartTime`	The starting time of the time range within which you want to retrieve the historical values.
`EndTime`	The ending time of the time range within which you want to retrieve the historical values.
`Count`	The number of values that you want to retrieve.

Output

In the **Output** tab, you can find the output results structured in the schema you specify in the **General** tab.

For the getSnapshot and getTagDefinition activities, results of only the tags that have matching data in the PI server are returned.

When you use the JDBC Query activity to get tag definitions, rounding errors might occur in the output results of certain tag attributes. For example, the tag attribute "comdevpercent" which is set to 37% might be output as 36.99999618.... For more information, see https://techsupport.osisoft.com/Troubleshooting/Known-Issues/119059.

Fault

In the **Fault** tab, you can find the error messages and error codes of the JDBC Query activity. For more information about errors, see Error Codes.

The following table lists the error schema elements in the **Fault** tab:

Element Name	Data Type	Description
msg	String	Displays the error message.
msgCode	String	Displays the error code.

Customizing JDBC Output Schema

The JDBC Query activity is provided with a defined schema for output that can be customized based on your requirements.

Prerequisites

Ensure that you have created the schema file. For more information about the schema file format, refer to the `Meta-model-template.xml` file under **Example** > **Schemas** > **Template**.

Procedure

1. From the menu, click **Window** > **Preferences**.
2. In the Preferences dialog, expand **Tibco Plugins** > **OSIsoft PI System**, and then click **JDBC Output Schema**.
   The **JDBC Output Schema** pane is displayed.
3. Next to the **schema preference** field, click **Browse** to specify the schema file that you have created.
4. Click **OK**. Your customized schema is ready to be loaded.

Working with Sample Projects

To understand how TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System works, you can run the sample projects packaged with the installer, which are located in the *TIBCO_HOME*/bw/palettes/pi/*version*/samples directory.

The BigData Sample Project

The BigData sample project demonstrates the sending of PI tag change events to a Hadoop Distributed File System (HDFS) by using the OSIsoft PI system plug-in and the Big Data plug-in. The Big Data plug-in of version 6.2 is supported.

To run the processes in the BigData sample project, you must install TIBCO ActiveMatrix BusinessWorks™ Plug-in for Big Data and configure the parameters.

The BigData sample project contains the following processes, and each process corresponds to a task:

- createschema.bwp

  Run this process first to create the schema for uploading data to the Big Data server.
- ErrorHandler.bwp

  This process is run automatically to check the errors when creating schema. You are not required to run it.
- tagchanges.bwp

  This process uses the AF TagEventListener activity to monitor and query tag changes.

The Example_AF Sample Project

The Example_AF sample project demonstrates the usage of the AF Server connection and the AF activities.

You must configure the OSIsoft PI System AF connection correctly to run the PIAF process.

The Example_AF sample project contains one process, that is PIAF.bwp, which shows how to use the AF activities to:

- Create and modify tags.
- Retrieve tag definitions.
- Set tag values.
- Retrieve tag values, including the latest tag value, the archival value with a specified timestamp, the historical values within a specified time range, and a specified number of historical values.

The Example_JDBC Sample Project

The Example_JDBC sample project demonstrates the usage of the JDBC connection and the JDBC Query activity.

You must configure the OSIsoft PI System JDBC connection correctly to run the processes in the Example_JDBC sample project.

The Example_JDBC sample project contains the following processes, and each process corresponds to a task:

- getArcvalues.bwp

  This process shows how to use the JDBC Query activity to get a specified number of historical tag values within a specified time range.

- getSnapshot.bwp

  This process shows how to use the JDBC Query activity to get the latest tag value.
- getTagDefinition.bwp

  This process shows how to use the JDBC Query activity to get tag definitions.
- PIJDBC.bwp

  This process shows how to use the JDBC Query activity to:

  – Get tag definitions.
  – Get the latest tag value.
  – Get the historical tag values within a specified time range.

Importing the Sample Projects

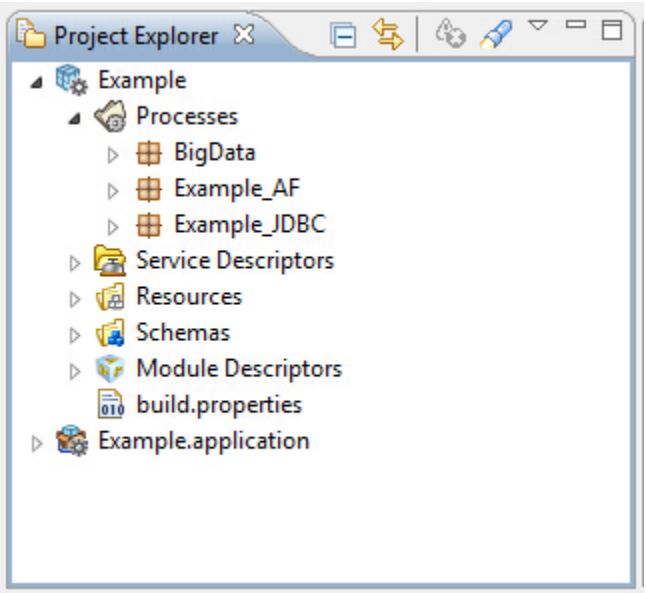
Before running the sample projects, you must import them to TIBCO Business Studio.

Procedure

1. Start TIBCO Business Studio using one of the following ways:
   - On Microsoft Windows: click **Start** > **All Programs** > **TIBCO** > *TIBCO_HOME* > **TIBCO Business Studio** *version_number* > **Studio for Designers**.
   - On Linux: run the TIBCO Business Studio executable file located in the *`TIBCO_HOME`*`/studio/`*`version_number`*`/eclipse` directory.
2. From the menu, click **File** > **Import**.
3. In the Import dialog, expand the **General** folder and select **Existing Studio Projects into Workspace**. Click **Next.**
4. Click **Browse** next to the **Select archive file** field to locate the sample. Click **Finish.**

Result

The sample projects are imported to TIBCO Business Studio.



Running the Sample Processes

After importing the sample projects, you can run the processes in them to see how TIBCO ActiveMatrix BusinessWorks Plug-in for OSIsoft PI System works.

Prerequisites

Ensure that you have imported the sample projects to TIBCO Business Studio. For more information, see Importing the Sample Projects.

Procedure

1. In the Project Explorer view, expand the **Resource** folder, and then expand the **example** shared resource.
2. Check that your connection is successful by completing one of the following steps:
   - Double-click **OSIsoftPISystemAFConnectionResource.piafResource** to edit the OSIsoft PI System AF connection, and then click **Test Connection** to validate your connection.
   - Double-click **OSIsoftPISystemJDBCConnectionResource.pijdbcResource** to edit the OSIsoft PI System JDBC connection, and then click **Test Connection** to validate your connection.
3. In the Project Explorer view, expand the **Module Descriptors** resource, and then double-click **Components**.
4. In the Components editor, select the process that you do not want to run and click the  icon.
   By default, all the processes for the application module are listed in the Components editor.

   To run the processes in the BigData sample project, ensure that you have installed TIBCO ActiveMatrix BusinessWorks™ Plug-in for Big Data.
5. On the toolbar, click the  icon to save your changes.
6. From the menu, click **Run** > **Run Configurations** to run the selected process.
7. In the **Run Configurations** dialog, expand **BusinessWorks Application** and click **BWApplication**.
8. From the right panel, click the **Applications** tab, and then select the check box next to **Example.application**.
9. Click **Run** to run the process.
10. Click the  icon to stop the process.

Managing Logs

When an error occurs, you can check logs to trace and troubleshoot the plug-in exceptions.

By default, error logs are displayed in the Console view when you run a process in debug mode. You can change the log level of the plug-in to trace different messages and export the logs to a file. Different log levels correspond to different messages. For more information, see Log Levels.

Log Levels

Different log levels include different information.

The plug-in supports the following log levels:

Log Level	Description
Trace	Includes all information regarding the running process.
Debug	Indicates a developer-defined tracing message.
Info	Indicates normal plug-in operations. No action is required. A tracing message tagged with Info indicates that a significant processing step is reached, and logged for tracking or auditing purposes. Only info messages preceding a tracking identifier are considered as significant steps.
Warn	Indicates that an abnormal condition occurred. Processing continues, but for best practice, you can contact the administrator to investigate it.
Error	Indicates that an unrecoverable error occurred. Depending on the severity of the error, the plug-in might continue with the next operation or might stop.

Setting Up Log Levels

You can configure a different log level for the plug-in and plug-in activities to trace different messages.

By default, the plug-in uses the log level configured for TIBCO ActiveMatrix BusinessWorks. The default log level of TIBCO ActiveMatrix BusinessWorks is `Error`.

Procedure

1. Navigate to the *`TIBCO_HOME`*`/bw/`*`version_number`*`/config/design/logback` directory and open the `logback.xml` file.
2. Add the following nodes in the **BusinessWorks Palette and Activity loggers** area to specify a log level for the plug-in:

```
<logger name="com.tibco.bw.palette.pijdbc.runtime">
   <level value="DEBUG"/>
</logger>
```

```
<logger name="com.tibco.bw.palette.pi.runtime">
   <level value="DEBUG"/>
</logger>
```

   The value of the **`level`** tag can be `Trace`, `Debug`, `Info`, `Warn`, or `Error`.

   If you set the log level to `Debug`, the input and output for the plug-in activities are also displayed in the Console view. For more information about each log level, see Log Levels.

3. Optional: Add the following nodes in the **BusinessWorks Palette and Activity loggers** area to specify a log level for an AF or JDBC activity:

```
<logger name="com.tibco.bw.palette.pijdbc.runtime.ActivityName">
   <level value="DEBUG"/>
</logger>
```

```
<logger name="com.tibco.bw.palette.pi.runtime.ActivityName">
   <level value="DEBUG"/>
</logger>
```

   For example, add the following node to set the log level of the AF TagDefinition activity to `Debug`:

```
<!--<logger name="com.tibco.bw.palette.pi.runtime.AFTagDefinition">
   <level value="DEBUG"/>
</logger>
```

   The activities that are not configured with specific log levels use the log level configured for the plug-in.

4. Save the file.

Exporting Logs to a File

You can update the `logback.xml` file to export plug-in logs to a file.

Procedure

1. Navigate to the *TIBCO_HOME*`/bw/`*version_number*`/config/design/logback` directory and open the `logback.xml` file.

   After deploying an application in TIBCO Enterprise Administrator, navigate to the *TIBCO_HOME*`/bw/`*version_number*`/domains/`*domain_name*`/appnodes/`*space_name*`/`*node_name* directory to find the `logback.xml` file.

2. Add the following node to specify the file where the log is exported:

```
<appender name="FILE" class="ch.qos.logback.core.FileAppender">
   <file>c:/bw6-osisoftpi.log</file>
      <encoder>
        <pattern>%d{HH:mm:ss.SSS} [%thread] %-5level %logger{36}-%msg%n</pattern>
      </encoder>
</appender>
```

   The value of the **`file`** tag is the absolute path of the file that stores the exported log.

3. Add the following node to the `root` node at the bottom of the `logback.xml` file:

```
<root level="DEBUG">
   <appender-ref ref="STDOUT" />
   <appender-ref ref="FILE" />
</root>
```

4. Save the file.

Error Codes

The following table lists the error codes, detailed explanations of them, and where applicable, ways to solve them.

Error Code and Message	Role	Category	Description	Solution
TIBCO-BW-PALETTE-PIAF-520001 `Some error occured when create/modify PIPoint`	errorRole	AF TagDefinition	An error occurs when creating or modifying the PI tag.	None
TIBCO-BW-PALETTE-PIAF-530001 `Exception occurred while processing Output for activity`	errorRole	AF TagEventListener	An error occurs when processing output for the activity.	None
TIBCO-BW-PALETTE-PIAF-530002 `There is no at least one valid tag`	errorRole	AF TagEventListener	No valid tags are found.	Ensure that the tags you listen to exist in the PI server.
TIBCO-BW-PALETTE-PIAF-530003 `Exception occurred while reconnecting detail message is {0}`	errorRole	AF TagEventListener	An error occurs when reconnecting to the PI server.	None
TIBCO-BW-PALETTE-PIJDBC-550001 `IOException occurred while retrieving XML Output for activity [{0}]`	errorRole	JDBC Query	An error occurs when retrieving XML output for the activity.	None
TIBCO-BW-PALETTE-PIJDBC-550002 `Exception occurred while processing Output for activity [{0} - {1}]`	errorRole	JDBC Query	An error occurs when processing output for the activity.	None
ERROR_OCCURED_RETRIEVE_RESULT.errorCode=500001 `IOException occurred while retrieving XML Output for activity [{0}]`	errorRole	General	An error occurs when retrieving XML output for the activity.	None

Error Code and Message	Role	Category	Description	Solution
ERROR_SHAREDSOURCE_MISSING.errorCode=500002 `Shared resource is missing`	errorRole	General	The shared resource is missing.	Check that a connection shared resource is selected from the **Server Connection** list in the **General** tab.
ERROR_OCCURED_INIT_GENERAL_MESSAGE.errorCode=500003 `Exception occurred while initialize input for activity [{0} - {1}]`	errorRole	General	An error occurs when initializing the input of the activity.	None
ERROR_OCCURED_BUILD_OUTPUT.errorCode=500004 `Exception occurred while processing Output for activity detail message is {0}`	errorRole	General	An error occurs when processing output for the activity.	None
ERROR_OCCURED_VALIDATE_INPUT.errorCode=500005 `The value of {0} field should not be 0`	errorRole	General	An error occurs when entering `0` for the parameter **`count`**.	None