QUICK GUIDE

FOR MODELING A PLANT

WITH PRECOG STUDIO

Version 3.1

November 2016

Contents

Purpose of this guide

The purpose of this guide is to provide quick getting started assistance to plant operation teams who are starting to model their plant.

Explanations in this guide are intended to be short and allow the person using the software to consult the documentation while doing actual work.

Screenshots in this guide refer to Precog demo site at http://46.101.162.93:8080/vp/manager/ . If you do not have access to the demo site, please request access via info@precog.co .

Projects

The modeling for each plant may be divided to one or more modeling projects. Experts can be assigned to a specific modeling project. Each expert can model different part of the plant. An expert is usually the processes engineer, asset manager, quality engineer, maintenance lead and their respective teams.

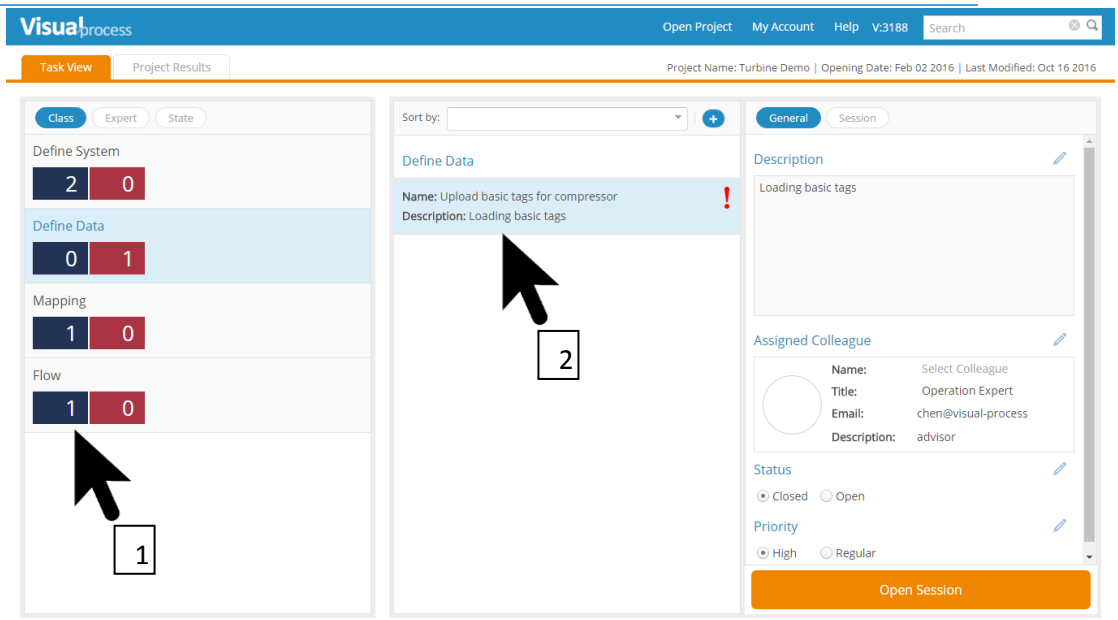
For more information about projects and how to create them please refer to: https://1drv.ms/v/s!AmPVD2OL0gXOhjXRGSJAmhTlJzvc

Tasks

1 Purpose of Tasks

Tasks allow the experts to divide the modeling work between them. The Task view is opened after choosing and opening a project.

2 Tasks View Main Parts



Tasks view is divided into three main parts. Task Classes (left pane), Task list (middle pane) and Task details (right pane).

3 Left Pane: Task Classes

Tasks are divided into four Classes (types). Each Class will open a specific modeling editor. As explained later, each modeling editor is constructed from different columns (Data, Domain Structure and Domain Behavior). Task Classes allow different experts to infuse their specific knowledge into the model.

Each Task class has two icons, Red and Blue. Pressing the red icon will show the completed tasks list. Pressing the Blue icon will show the on-going tasks list. The numbers on each icon represent the number of tasks in each list.

Coloring, Classes and Class Icons may be different at each implementation.

1 Pressing a task class icon will open the Tasks List for this class in the Middle Column.

4 Middle Pane: Tasks List (within a Class)

The Task List allows the user to select the task he or she needs to work on.

2 Pressing a task will open the specific Task Details on the Right Pane

5 Right Pane: Task Details

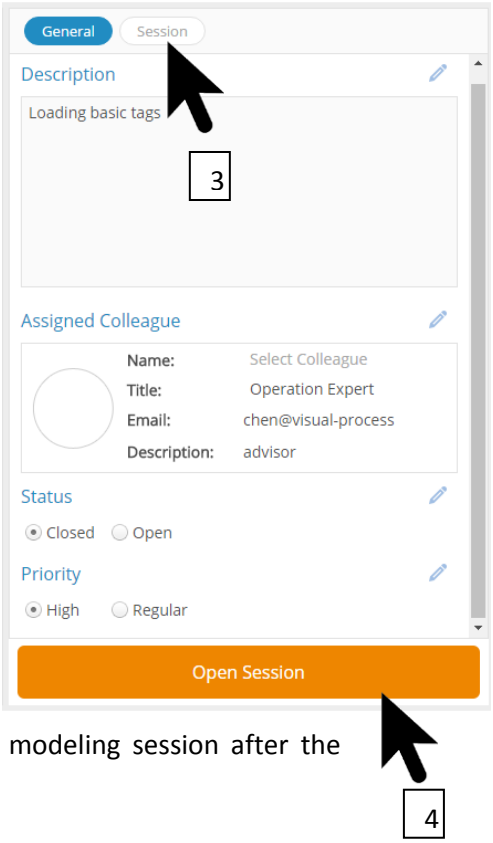
5.1 General

At the Task Details pane, under General, the user may edit the tasks details by pressing the pencil icon

By changing the *Status* from *Open* to *Closed* the task will be counted at the applicable color at the Classes Left Pane

5.2 Sessions

Each time the user presses *Open Session* a session is created and the modeling editor is opened.



3 Press *Sessions* for the history of sessions for each task

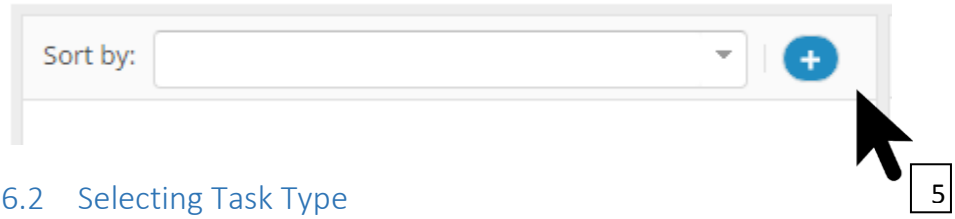
4 *Open Session* will start a modeling session

Note that it is a good practice to fill the description of each modeling session after the modeling session is finished.

6 Creating a Task

6.1 Creating

5 To create task press on the *+* icon at the top of the Middle Pane.

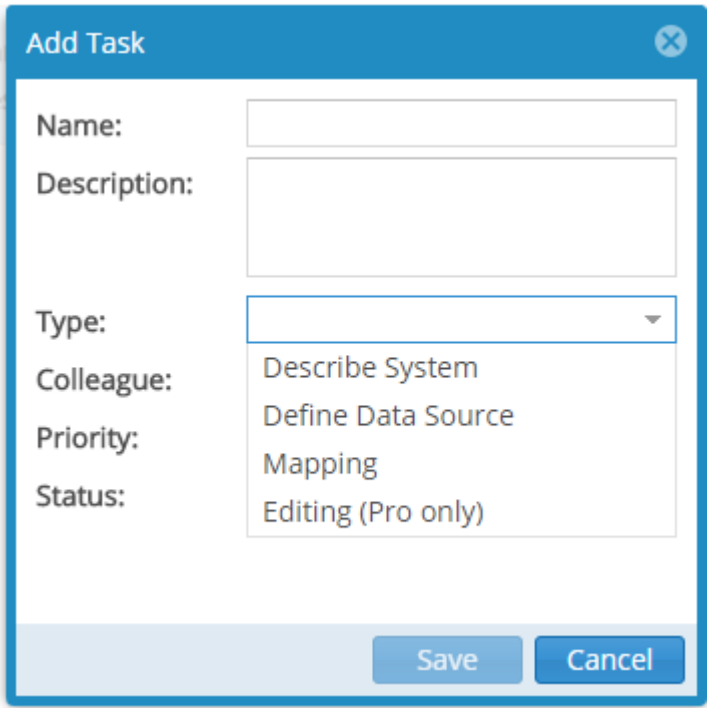


6.2 Selecting Task Type

To support different aspects of the modeling process, shorten the modeling time and optimize the usage of screen space, there are 4 types of tasks. Each class type enables the expert to open different modeling possibilities:

Task Type Name	Editors that will appear	Purpose	Appear in Class (at Left Column)
Describe System	Domain Structure, Domain Behavior	Modeling the plant without making connections to data	Define System

Define Data Source	Data, Domain Structure	When linking tags to their relevant location in the plant	Define Data
Mapping	Data, Domain Structure, Domain Behavior	Modeling all aspects at the same time (cons: cluttered screen)	Mapping
Editing	Open OPM editors	Only for pure modeling purposes.	Flow



6.3 Other Task Properties

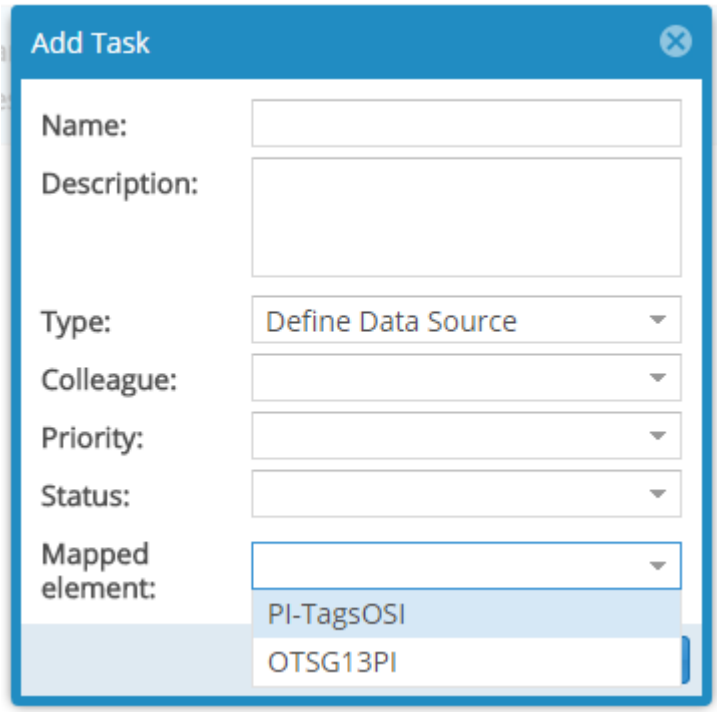
Provide each task with meaningful name, description and who is the primary expert who is responsible for the task. High priority will place the ! Icon next to the task at the Task List in the Tasks view, Middle pane.

6.4 Mapped element

Selecting a Mapped Element allows you to load only part of the plant model or only some of the data sources together with the current task. If left blank all plant parts and data sources will be loaded.

Task Type	Available Selection
Describe System	Parent system from Domain Structure

Define Data Source	Single data Source
Mapping	Single data Source



6.5 Starting a Session

To start a modeling session for a specific task, do the following:

Left Pane (Classes): Press the number on the *Class* of the Task>

Middle Pane (Task List): a list appears select the *Task* you want to work on>

Right Pane (Task Details): press the *Start Session* orange button

Modeling

This part will guide you how to build a model of your plant.

All actions in all the modeling editors are done by RIGHT-Clicking on an entity. Double-click an entity allows you to change the entity name.

7 Step 1: Loading Data Source

7.1 Prepare data headers

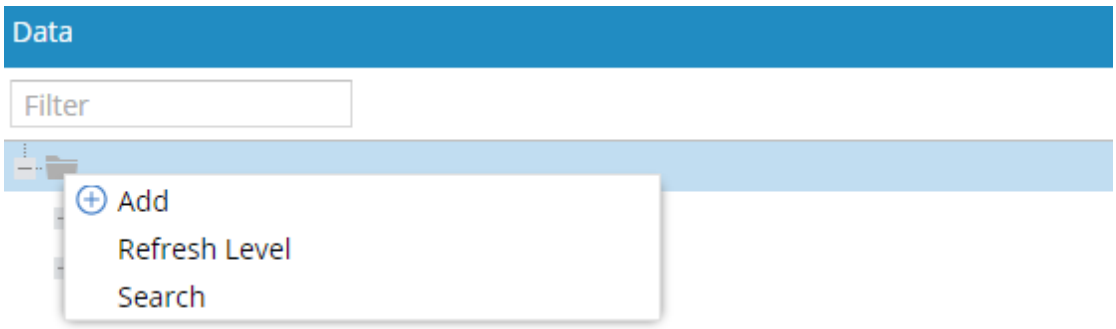
Before starting, prepare a one-line CSV file with all the headers of the data you are planning to load into the system (referred to as "Tags"). The file shall be arranges as one line in which all the Tags are present separated by comma (tag1, tag2,…. Tag*n*).

7.2 Create task

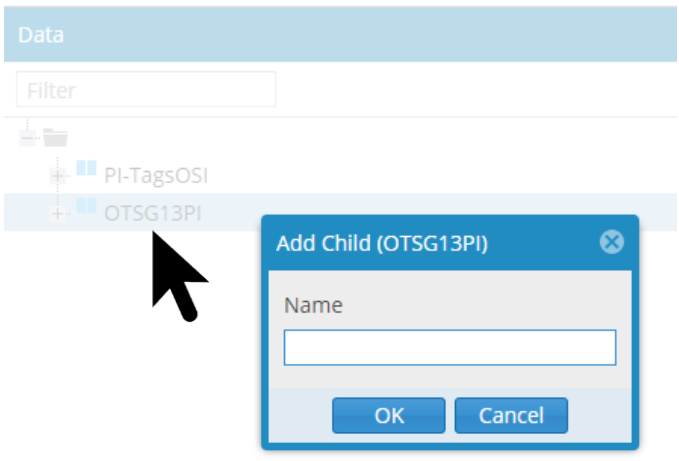
- Create a *Define Data* task (see explanations above)
- Open a *Session* for this task (see explanations above)

7.3 Add a Data Source

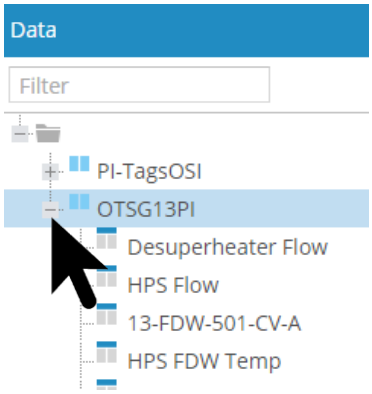
- Add source by right clicking the root element in the Data Column



- Next provide the required details.
- Next right-click on the new source of data you created. Now copy the list of tags from the CSV you prepared earlier and paste it into the dialog box. The tag list will be created.



- Press on the small + icon next to the source name to open the list of tags



7.4 Adding tag names to existing source

To add more tags to an existing source repeat steps 1, 6 and 7 above. If you are adding only few tags you may skip step 1 and type them into the dialog (step 6) separated by comma.

7.5 Changing tag name

During the initial modeling when Precog is **not** operational: double click on the tag and change the name.

When Precog is operational: contact your system admin. Other parts in the system are relying on the tags naming for data connectivity.

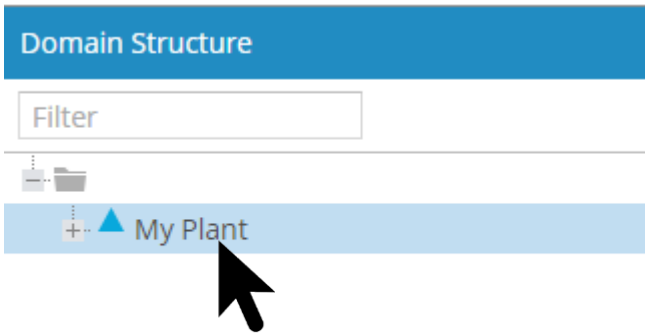
8 Step 2: Modeling the plant hierarchy

Plant hierarchy represents the plant physical structure as the expert or experts see it.

Note that there is no “right way” to model the plant structure, the modeled structure is the way the modeler understands the plant. Precog will infer from the complete model, the data and structure it needs to generate meaningful events.

8.1 Building the Hierarchy

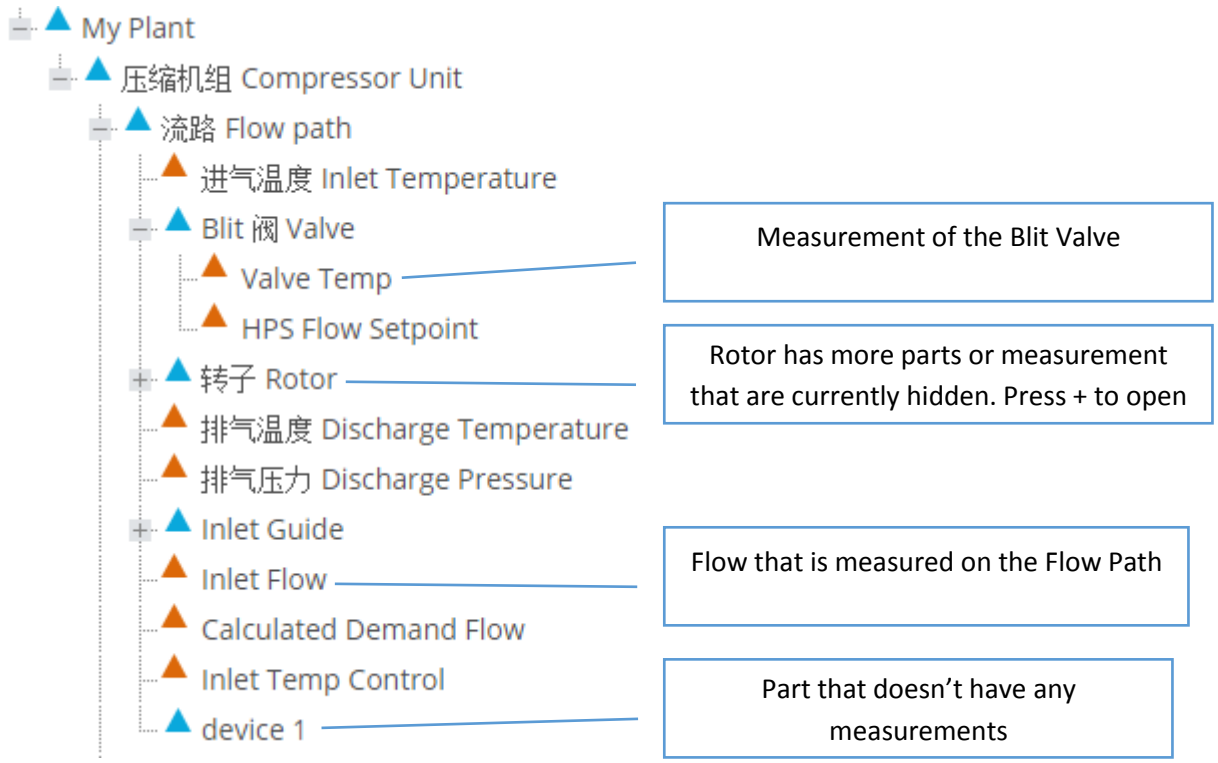
- Create a *Describe Data Source* task (or use an existing task).
- Double-click on the top entity on the *Domain Structure* tree and change its name to your plant’s name.



- Add the main subsystems of your plant (preferably not more the 10) by right-clicking on your plant name and selecting *Add.* Leave the selection on *Part of* (default) and provide the name of the first subsystem. Repeat this process until all subsystems are selected.
- For each subsystem (which has measurements (tags) on it):
  - If there are measurements for the entire subsystem (and not to parts thereof): Right-click on the subsystem>select *Add*> change selection to *Property*> provide meaningful name for the measurement (e.g. Turbine temperature)*>Press *Add*.
    * Entity names must be unique in the hierarchy. Therefore, the name cannot be *temperature,* but *Turbine XYZ Rotor temperature*. Names should be meaningful to the modeler and not the names as they appear in the database. Measurements will appear in the hierarchy as Orange triangle.
  - Repeat step 3 above:
    Right click on the subsystem> add all its subsystems one by one
    For each subsystem check if there are measurements> if so, add by right click and change to *Property*> continue to add subsystem to subsystems in a recursive process.

8.2 Stopping condition point for Domain Structure

- Where to Stop: Do not add more levels of details to an entity if there is nothing measured at that level. See example:



- Measurement that represents several sensors: if there are several sensors measuring the same thing, you may use one measurement and connect all the tags to this measurement.

- Note that if the structure is built incorrectly or not deep enough, the resulting events will reflect it, after the data is on-line. The experts can then to go back to the model and fix the structure or add additional depth to the model. This approach is intentionally allowing the modeling team to start with a simple model and improve it later.

8.2.1 Elements in the Domain Structure

The Domain Structure includes primary Systems, subsystems, components and parts of your plant, but it can include more elements (all referred collectively as “Objects”). It may include from example people-the man in the loop- a hierarchy of rules that are relevant to the operation of the plant. It may also include consumables and products of the plant. A hierarchy of products may be added to the tree. Adding these types of Objects will enable Precog to provide clearer results but is not mandatory.

8.3 Connecting Tag names to Domain Structure

Once the Domain Structure is modeled and tag names are loaded an expert can connect the *Data* headers (tag names) to the *Domain Structure*. The connection is between a tag name on the left pane and a measurement (marked in Orange) in the Domain Structure pane. The connection can be a many-to-many relationship.

Example:

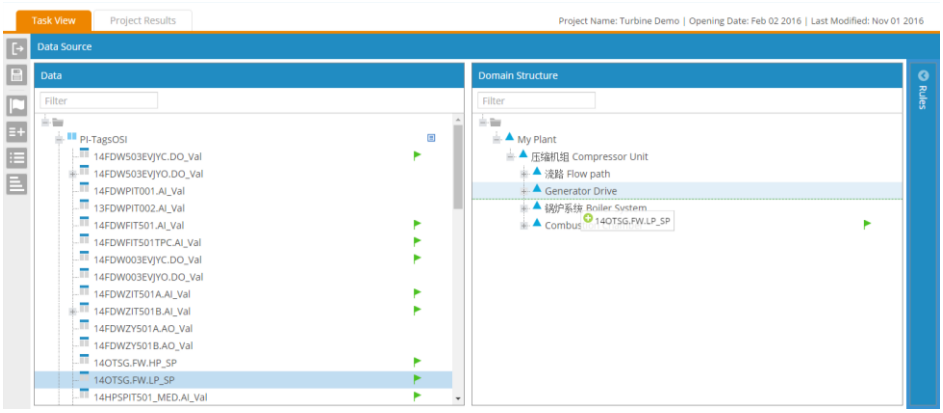
There are 12 sensors measuring the temperature of the combustion chamber. The expert will connect all of them to one Temperature measurement under the Combustion Chamber.

On the other hand, there may be a temperature sensor that measure the connection point between Pipe A and Pipe B. In such case your model may look as follows:

Pipes >Pipe A>Pipe A connection point temperature
> Pipe B> Pipe B connection point temperature

The data tag in such example will be linked to both *Pipe A connection point temperature* and *Pipe B connection point temperature.*

When you link an tags from the Data pane to elements in either the Domain Structure of Domain Behavior, a small green flag will appear next to both to signify that a connection exists (see explanation below on how to view and delete connections).



8.4 Building Plant Processes

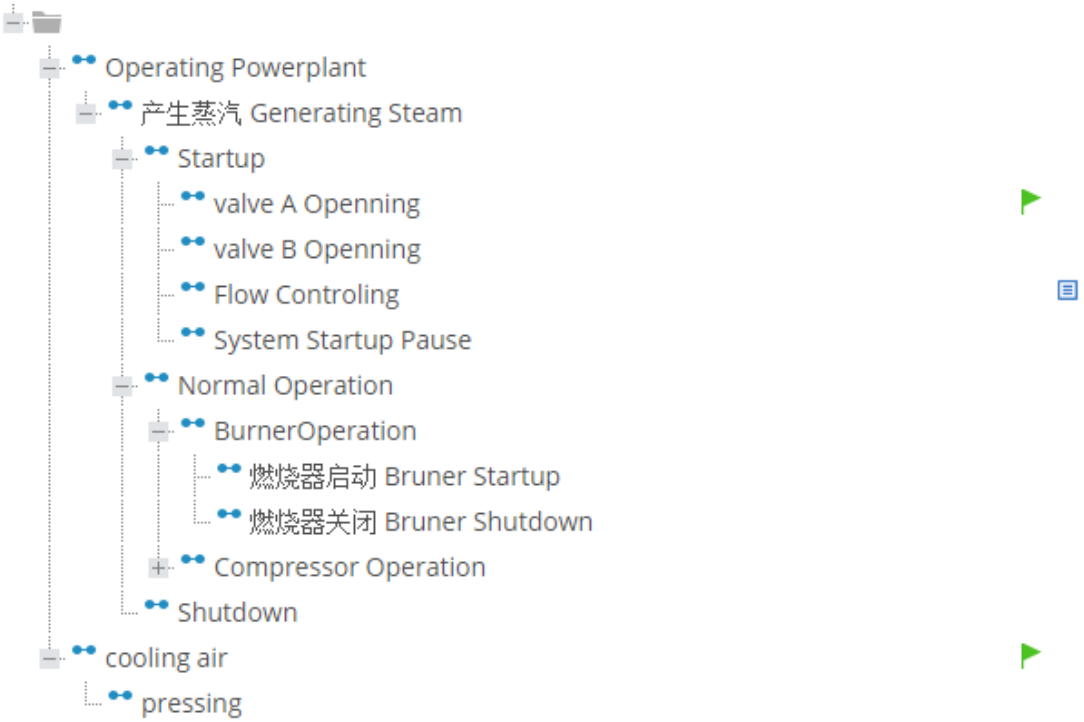
Domain Behavior is modeled in the right pane. Each element signifies a process in the plant. In Precog processes change, create or consume Domain Structure objects. For example, the process of "heating" effects the "boiler" object.

8.4.1 Building the Domain Behavior

- Create a *Describe System or a Mapping* task (or use an existing task).
- Double-click on the top entity on the *Domain Behavior* pane (named *Process* as default). Change its name to the text of what your plant is doing. This is the high-level function of your plant (generating electricity, producing special chemicals etc.).
- Next right click on the main process, select *Add* and add the 3-6 main processes that are happening at your plant. Try to keep the following principles
  - Do not add more than 6 processes under a single process
  - If you are modeling in English, try to finish each process name with "ing". This will help you to focus on processes. ("Heating", "Generating"…)
  - Give each process meaningful names ("*generating electricity*" is better than "*processes done by turbine* X")

Repeat by adding sub-process for each parent process you created. We recommend to detail each process, it sub-processes, grand-sub-processes etc., before moving to the next thread of processes. Try to add sub-process in sequence.

Summary example: if we had a process of *Starting the turbine* then its sub-processes may be: *Supplying fuel*, *Burning Fuel* and *Lubing*. Supplying Fuel may be divided to *Supplying Liquid Fuel* and *Supplying Natural Gas* and so on.



8.4.2 What processes to include?

Like the Domain Structure, there can be several options on how to model the behavior of a plant. You, the expert need to create a structure which is represent the plant in your eyes. You may create several structures of processes, each representing a different aspect or sequence.

The formal definition of a process is: "A process is a pattern of transformation (consumption, change, or generation) that objects (i.e. parts or systems) undergo. There may be different strategies to building the process tree. Here are some examples:

- Sequence of operation: start, steady, shutdown and then describe the different sub-processes at each step.
- The main processes in the plant: Generating electricity (compound of turning fuel to rotation and turning rotation to electricity).
- Maintenance processes and control processes.

This options are not mutually exclusive. You can build few process hierarchies each representing a different strategy.

8.4.3 Stopping Point for Processes

You can continue to add sub-processes and sub-sub-processes forever. The rule for processes is to stop when a process is effecting only one Domain Structure entity. If for example the process of *Pumping purified water* is done by *Electric Pump 2* and you decided not to break the Electric Pump 2 into sub-components and no other part in the Domain Structure is also involved in the *Pumping purified water,* then this process is your stopping point. There is no practical use in describing its sub-processes.

8.4.4 Connecting processes and Objects

Connecting Processes to Objects is the glue which holds the model together. The connections between the Domain Structure and Behavior are the facts which allow Precog to infer the correct events given the modeler own view on the plant.

For each added process, ask yourself: "which parts are participating in this process operation in any way".

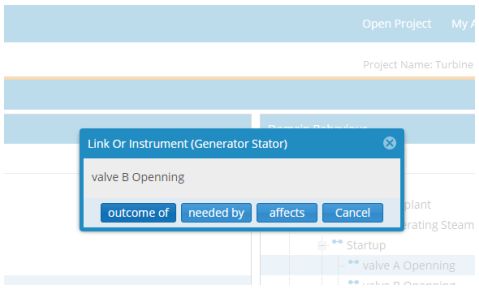
Now find this part at the Domain Structure tree and drag it onto the process. There are few general rules for selecting the right level in the Domain Structure to link:

- If all the subparts in a system participate in a process, you can drag a link from the parent system and you don't have to connect each subsystem
- If only some of the parts in a system participate in a process, then you need to connect each of parts those parts that participate to the process.

As you continue and create more granular levels of sub-processes you will see that the connections are becoming more specific.

8.4.5 Selecting the right link

ISO standard caters for several types of links. For Precog predictive maintenance purposes we selected the most important links:

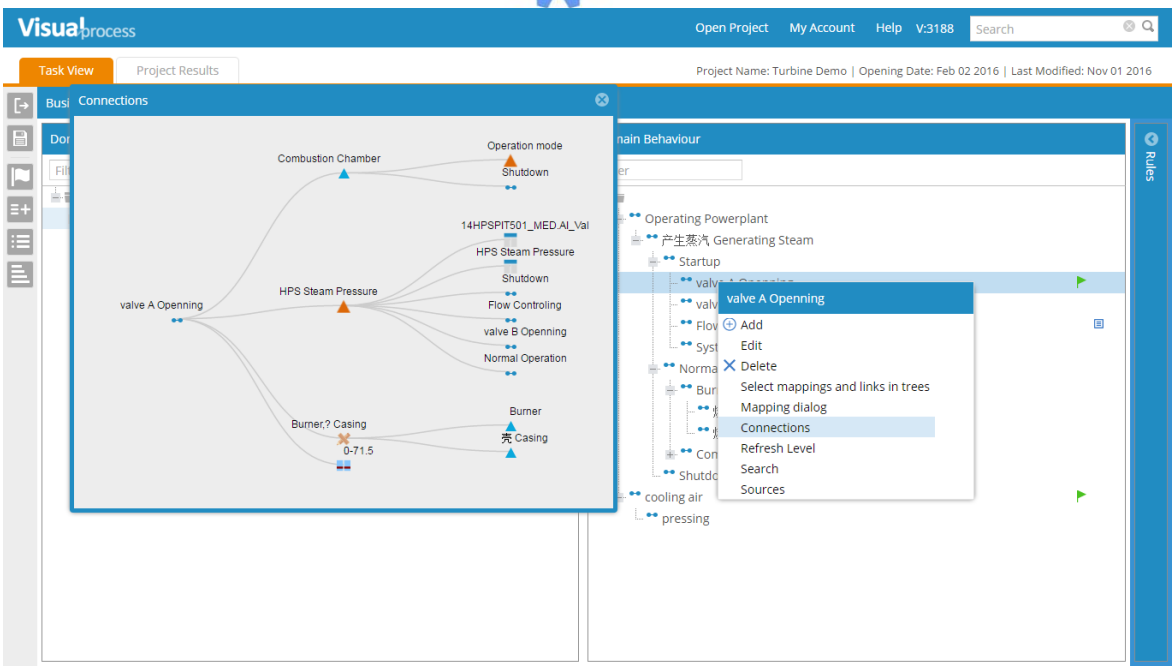


Connection Type	When to use
Outcome of	When the Object is an outcome of the process. For example, *Electricity* is the outcome of *Generating Electricity* process.
Needed by	When the Object is needed for the Process to happen, but is not materially affected by it. For example, the *Turbine* is needed by the process of *Generating Electricity*. It is clear that the turbine is also affected by the process (wear and tear), but this is not the essence of the process.
Affects	In this case, the Process is affecting the Object. For example, the *Pumping* process is affecting the *Water level* in the *Tank.*

8.4.6 Review and delete connections

To review if an entity is connected, right click on it and select *Connections*.

To delete existing connections right click on the entity and select *Mapping Dialog.* Press the *X* to delete the existing connection.



Summary

This “Getting Started” guide provides the basic knowledge needed to model in Precog studio. Precog support team is available for any question at info@precog.co .