Configurator Services

Sample Application

Document #: 01.01.2018012201

Last Modified: *1/26/2018*

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Document Conventions

The following table highlights the document conventions used in the document:

Table 1: Document Conventions

Convention	Description
Bold	Emphasizes the names of menu items, dialog boxes, dialog box elements, and commands. Example: Click **OK**.
`Code`	Code examples appear in `courier` font. It may represent text you type or data you read.
`Yellow highlight`	Code highlighted in yellow draws attention to the code that is being indicated in the content.
`Yellow highlight with red text`	Red text highlighted in yellow indicates the code parameter that needs to be changed or replaced.
Italics	Reference to other documents.
	Notes contain additional useful information.
Warning	Warnings contain important information. Pay special attention to information highlighted this way.
Successive menu choices	Successive menu choices may appear with a greater than sign (-->) between the items that you will select consecutively. Example: Navigate to **File** --> **Save** --> **OK**.

1 Overview

Aras Configurator Services has been developed to make Variant Management easier for customers by providing APIs that enable developers to create custom variant management applications. The Sample application is designed to show developers how they can use the Configurator Services API to create custom applications.

The sample application is an Aras Community Project. It is not a standard product, and should not be deployed to production as-is. The purpose of the sample application is to demonstrate the Configurator Services API capabilities so that custom applications can be built to address specific business requirements and processes.

Sample data is provided along with the sample application. Loading the sample data is optional. The purpose of the sample data is merely to help follow this documentation within your sample application installation.

1.1 Terminology

The following table defines the terms, acronyms, and abbreviations used in this document.

Table 2: Terminology

Term	Definition
Scope	An in-memory item that contains Families with a list of Options that can be assigned to the Family, and Rules that define relationships between assigned options.
Combination	A specific combination of Options from different Families.
Technical Solution	Denotes a specific Part for the variant of a Generic Item. For example, Part No. P8301 is the technical solution for 19” Alloy Wheels.
Configurable Structure	A structure that contains both variable and fixed content. The structure’s variable content is attributed by an expression, which specifies the condition where it is used.
Generic Item	A node in a configurable structure.
Leaf Generic Item	The Leaf level of a configurable generic structure. The Leaf Generic Item is where Technical Solutions are attached. The attached technical solution may have its own multi-level structure.

2 The Data Model

The following table defines the components that make up the Sample Application Data Model.

Table 3: Sample Application Data Model

Name	Definition
ItemTypes/RelationshipTypes	For ItemTypes/RelationshipTypes created in the sample application, the prefix is *cs_sample_*.
Family	A set of Options grouped together to create a product characteristic such as Wheel Size.
Option	A discrete choice for a product characteristic. For example, Wheel size options: 17”, 18”, 19”
Rule	Specifies which Options from various Families either can or cannot go together.
Options in Family	A relationship between Family and Option. A Family can have one or more options. An Option can be used in one or more Families.
Generic Item	A node in a configurable structure.
Generic Structure	A relation between two Generic Items. It is used to create a multi-level structure. A Generic Item can have zero, one, or more Generic Items as child items. It can also be used in one or more Generic Items.
Relevant Families	A relation between Generic Item and Family. It is used to associate Families that are relevant to a Generic Item. A Generic Item can have zero, one or more Families. A Family can be used in zero, one or more Generic Items.
Usage	A relationship between a Leaf Generic Item and a Technical Solution. It represents the resolution definition from a Generic iIem to a Technical Solution. In the sample application, Part is used as the Technical Solution to Generic Items. On the relationship, the “definition” property indicates which Option(s) or Option combination(s) a Part is used as the Technical Solution for a Generic Item. A Generic Item can have one or more Parts with different select conditions. A Part can be a Technical Solution to one or more Generic Items.

3 Features

The following features are included in this release:

The **Text Rule Editor** is used to manage rules for a particular scope. It uses Families and Options within the specified scope and provides guidance when creating rules. It supports IF, AND, OR, NOT, THEN, EQUAL, EXACTLY-ONE, AT-MOST-ONE, AT-LEAST-ONE statements.

The **Table Rule Editor** is also used to manage rules within a particular scope. It uses Families and Options within the scope. It displays the rules in a table showing primary and secondary constraint Families.

The **Usage Expression Editor** is used for editing select usage conditions. It uses Families and Options that are within scope and provides guidance when you create expressions. It supports AND, OR, NOT, THEN, EQUAL, EXACTLY-ONE, AT-MOST-ONE, AT-LEAST-ONE statements. An empty statement used for fixed content.

The **Variant Tree** displays the valid configurations for a structure in a tree branch view.

Validate Usages analyzes Leaf Generic Items that have missing or multiple usages assigned. Where "missing" is a Generic Item that does not have a Usage assigned, "multiple" is a Generic Item that has several Usages that can be resolved as valid for at least one combination of Options.

Selecting Options to Resolve a Structure displays a list of Families used in a specific scope. You can select Options from the list for each Family. Invalid Options appear in red.

Validate Option Selections checks to see if the selected Options are valid based on the Rules. It returns either valid or invalid.

Get Reasons for Invalid Option Selections shows a UI representation of Rules and Families restrictions that are the cause of the invalidity.

Resolve Structure resolves the structure based on the Options you select and the Usages assigned to the Leaf Generic Items. Resolved items and Parts are displayed at the leaf level.

In the sample application, the Scope object passed to Configurator Services APIs is the Generic Item, which is the item in context in the UI, along with its multi-level generic structure, Relevant Families (with Options) and Rules associated with the Generic Item in context as well as all Generic Items within the multi-level structure. The custom builder methods build this Scope object.

4 Detailed Description of the Sample Application

The sample application for Variant Management demonstrates how configurable product data can be managed by leveraging commonality and assigning variability where it applies. The sample application enables you to:

Create a multi-level configurable generic structure (e.g. 150% BOM).

Define Families, Options, and Rules (FOR) on the configurable generic structure.

On generic leaf level items where there is variability (i.e. variable content), relate Technical Solutions with usage conditions.

On generic leaf level items that are included in all configurations (i.e. common content), relate Technical Solutions.

Resolve configurable generic structure to a 100% structure by selecting an Option from each Family.

Partially configure the generic structure by selecting Options from some of the Families.

Validate if the selected Options are valid for the generic structure.

For an invalid Option combination, find the Rule(s) that invalidate that combination.

Find the Generic Items in a structure that have either missing or multiple Technical Solutions for a given Option combination.

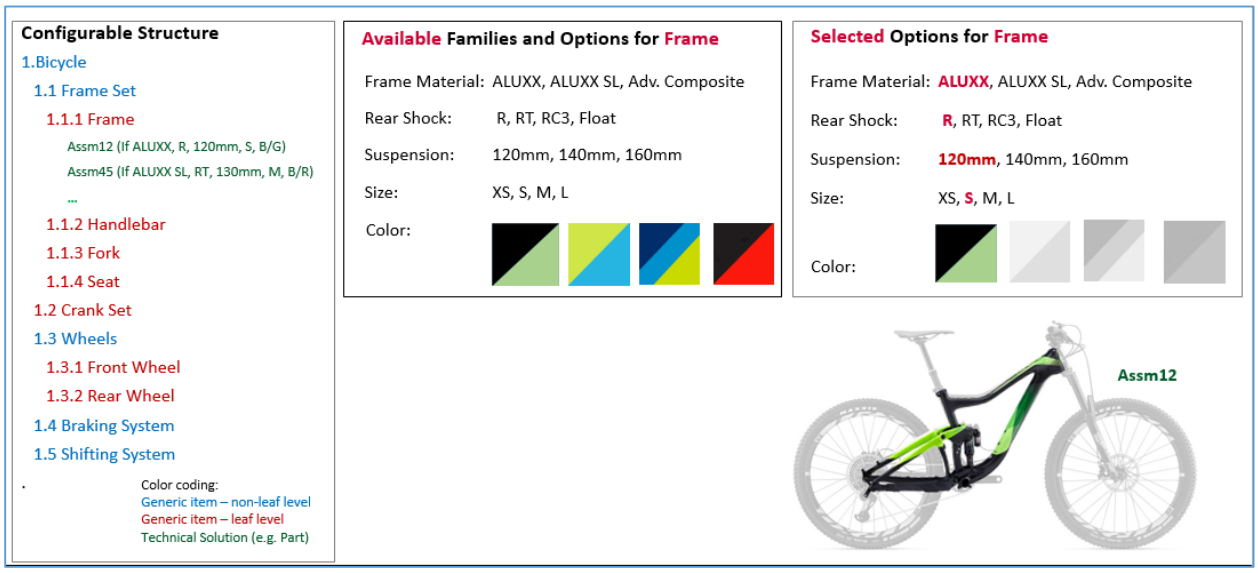


Figure 1.

The sample application installation package also includes optional sample data. If you choose to load the Variant Sample Data, a structure of Generic Items, Families, Options, and Rules is loaded. See Appendix A: Sample Data Outline for an outline of the sample data. Review the sample application installation instructions for the steps to load the optional sample data.

4.1 Description of Generic Item Icons

For Generic Items, the following icons will be available in the sidebar.

Table 4: Icon Descriptions

Icon	Icon Name	Description
	Form of Generic Item	The form for the Generic Item. In the case of Generic Items with a structure, the child Generic Items are related under the “Generic Structure”.
	Relevant Families	View and maintain the Families and Options associated with the Generic Item.
	Table Rule Editor	Create, view or modify the Rules associated with the Generic Item. This editor displays a list of existing Rules that you can view or modify in the Rule Expression section of the window.
	Text Rule Editor	Create, view, or modify the Rules associated with the Generic Item. This editor contains a Properties tab that enables you to view the Properties and definitions associated with a Rule.
	Variant Tree	View the Variant tree associated with the Generic Structure.
	Usages	View, relate, and update Technical Solutions with Usage conditions for the Generic Item.
	Validation and Resolution	Select and validate Option combinations, find Rules that disallow an Option combination, validate missing or multiple Usages for given Option combination, and resolve the Generic Structure for the selected Option combination.

4.2 Creating a Generic Item

To create a multi-level configurable Generic Structure, Generic Items need to be created.

1. Select Configurator in the TOC and select **Generic Item**.

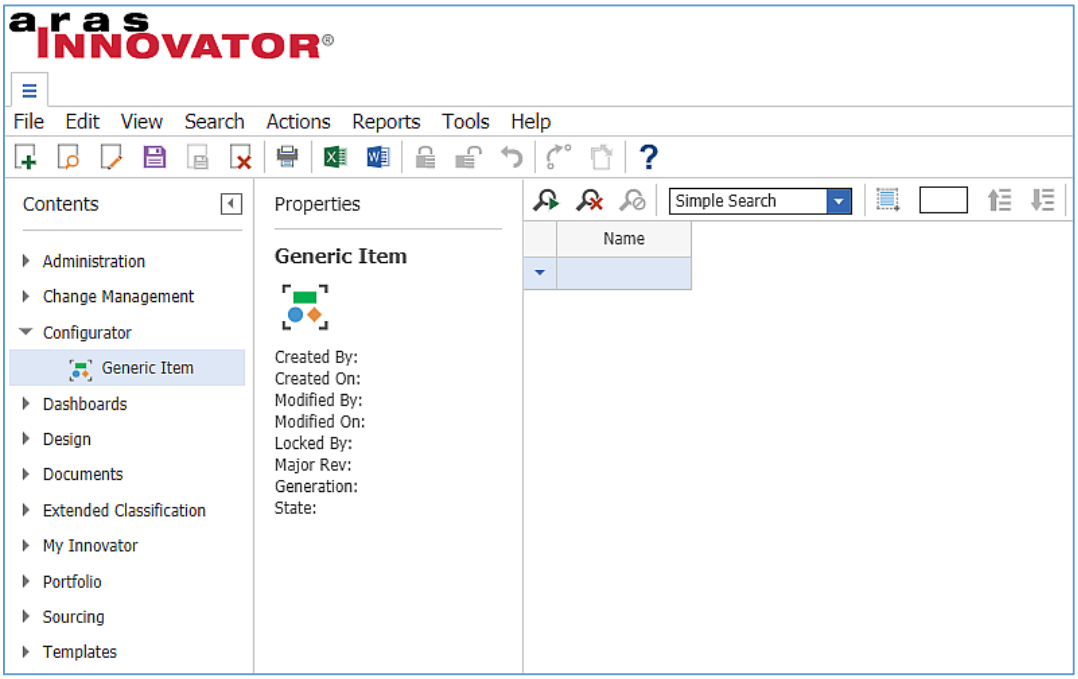


Figure 2.

2. Click the **Create a New** Item icon  . The Generic Item screen appears.

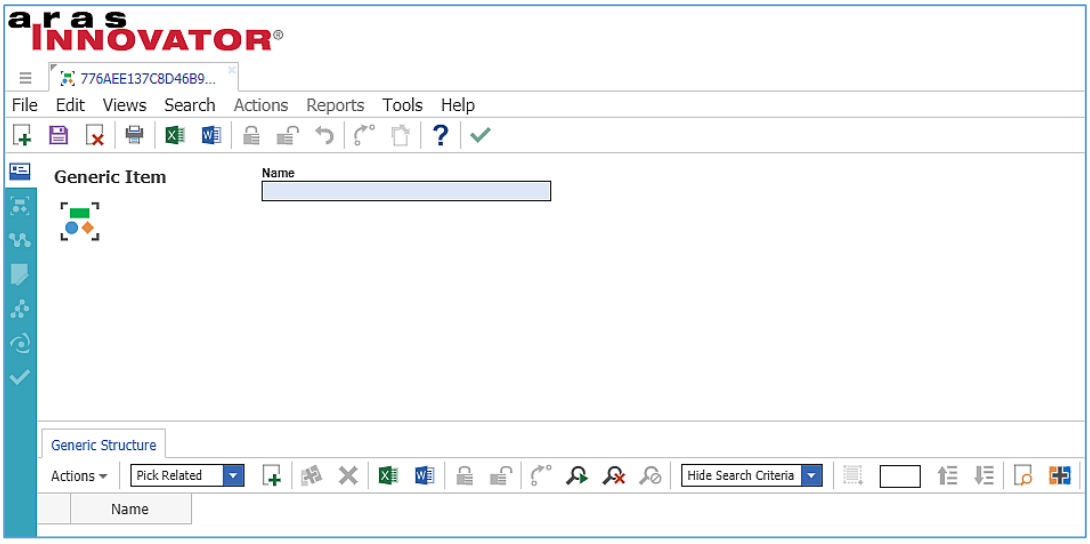


Figure 3.

3. Enter the name of the generic item in the Name field and click Save. The icons that appear in the sidebar are activated.

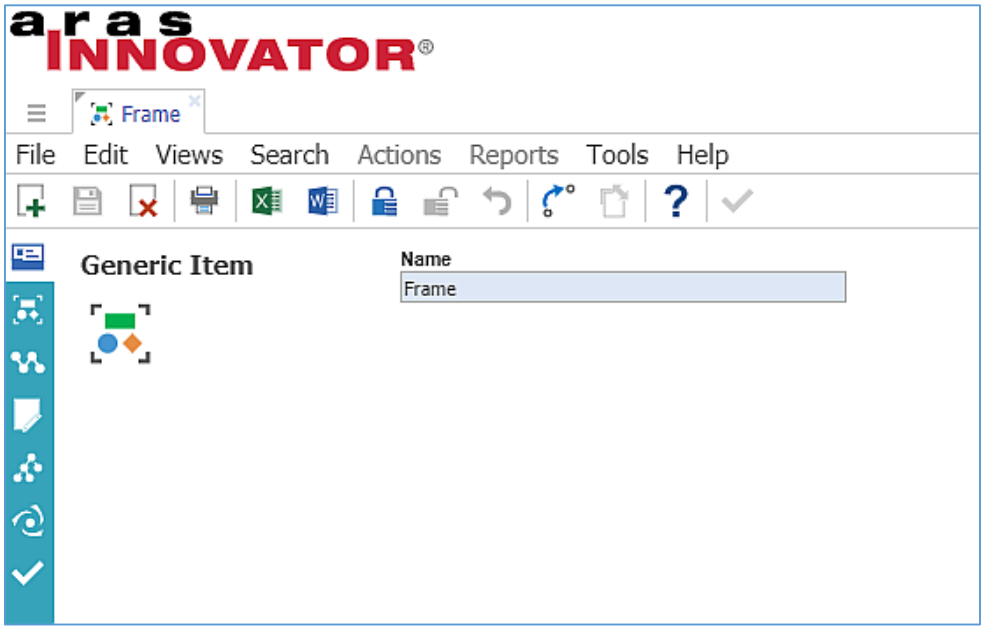


Figure 4.

4.3 Adding a Family to a Generic Item

You can associate Relevant Families to the Generic Item. Lock the Generic Item to allow updates and use the following procedure to add a Family:

1. Right click on the Generic Item to access the context menu.

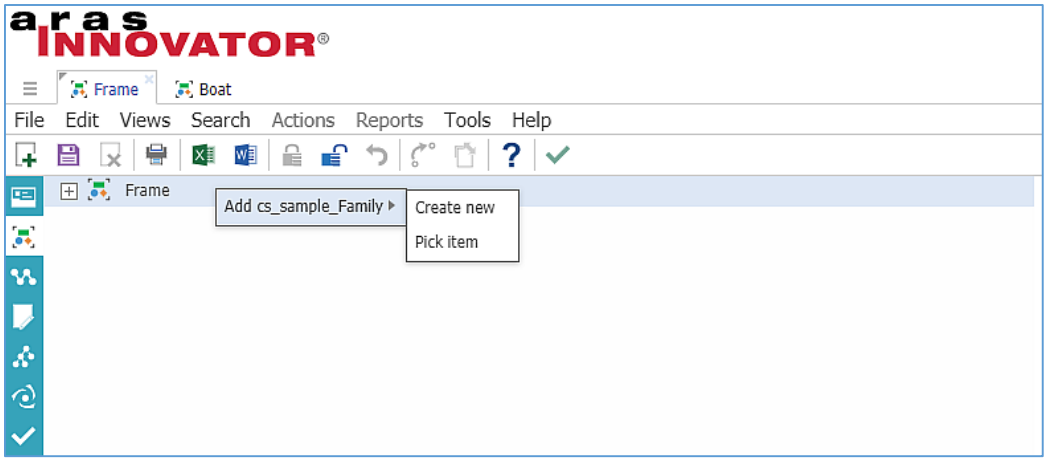


Figure 5.

2. Select either **Create new** to create a Family or **Pick item** to search for an existing Family and add it to the Generic Item. The Family form appears:

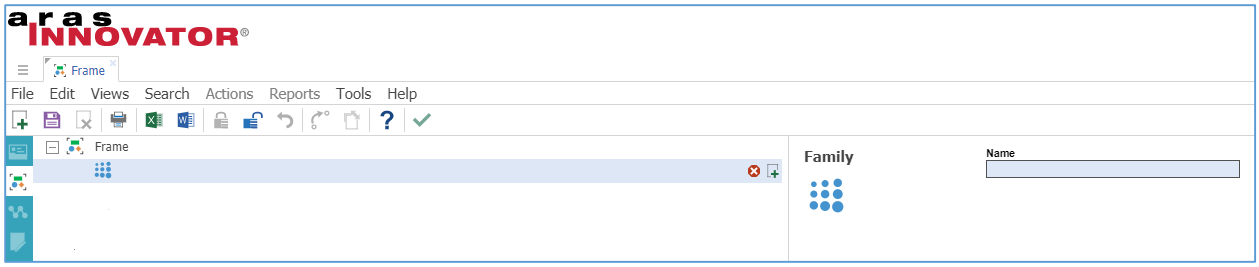


Figure 6.

3. Enter the family name in the Name field and click **Save**. The Family you created appears in the tree.

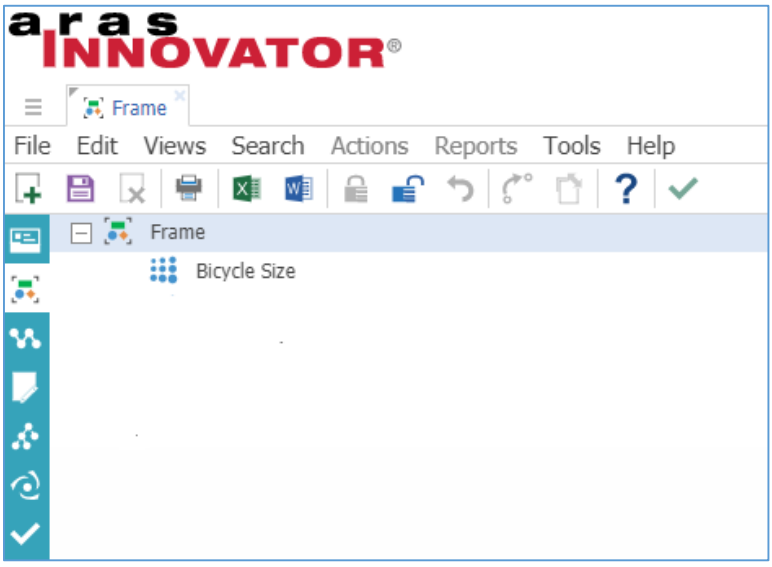


Figure 7.

4.4 Adding Options to a Family

Now that you have a Generic item and a Family, use the following procedure to add Options to the Family:

1. Click on the Family. Right-click and select **Add Option> Create new** from the context menu. The following screen appears:

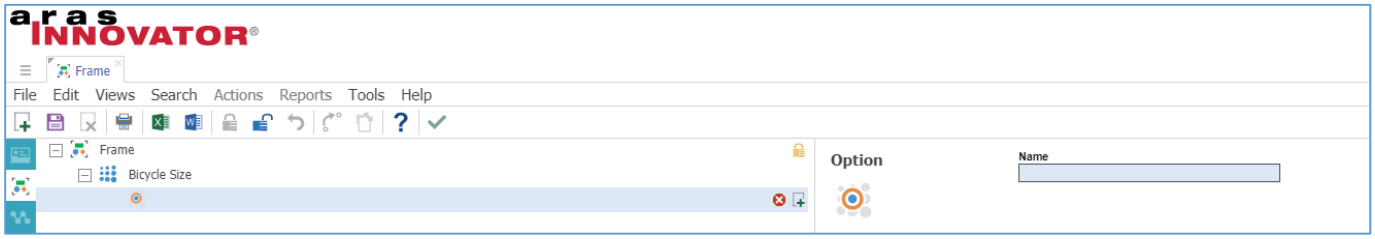


Figure 8.

2. Enter the name of the Option in the **Name** field and click the **Save** icon. The option you created is added to the Family. You can add as many Options as are necessary.

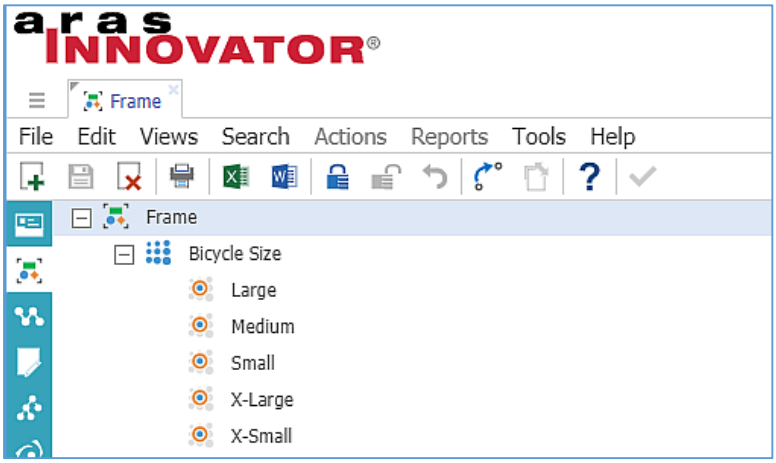


Figure 9.

3. Continue to add Families and Options, as shown here:

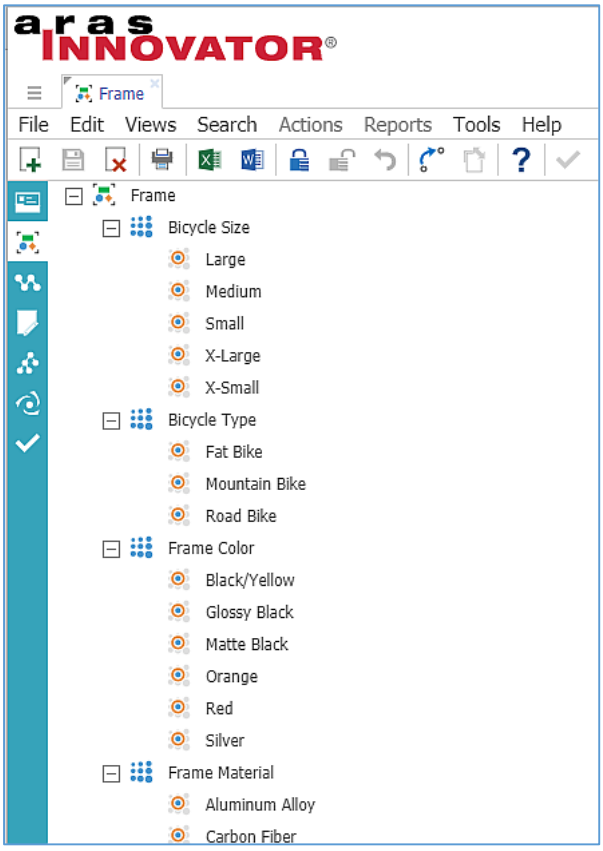


Figure 10.

4.5 Deleting Options from a Family

Use the following procedure to delete an unused Option from a Family:

1. Click the **Relevant Families** icon to see the Families and Options associated with the Generic Item. Lock the item to make updates.

2. Right-click the Option you want to remove and select **Unpick** from the context menu:

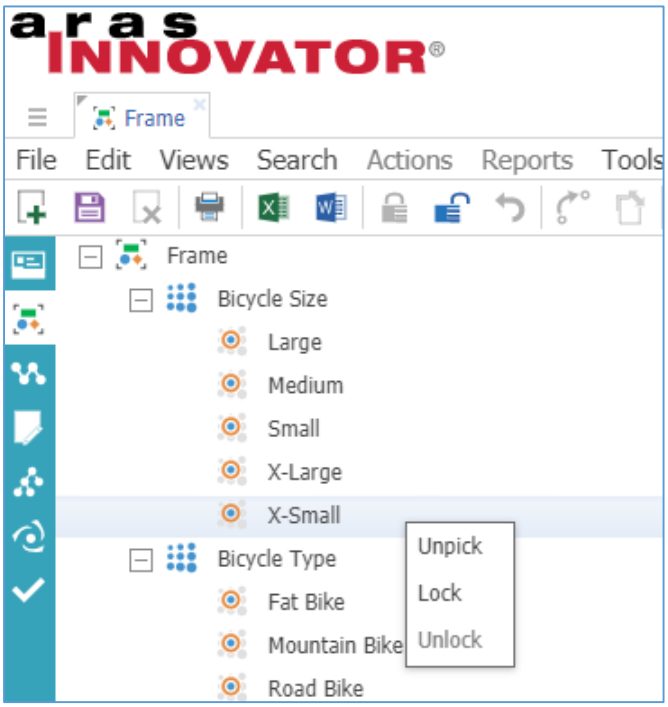


Figure 11.

The Option you selected is grayed out, as shown here:

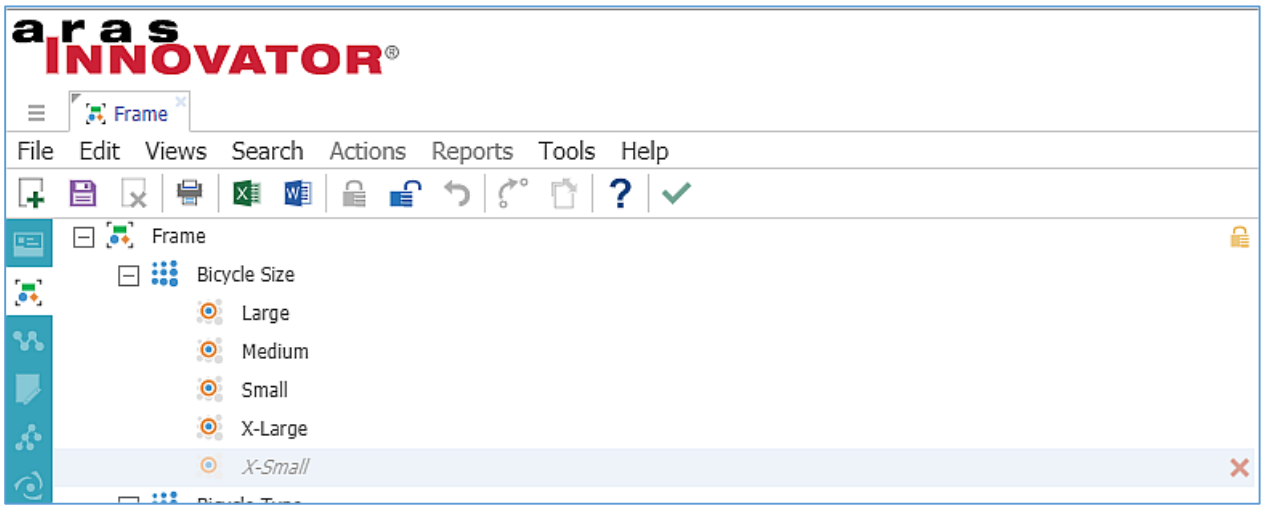


Figure 12.

3. Click **Save** and then select the unlock icon to unlock the structure. The grayed out Option is removed from the Option list.

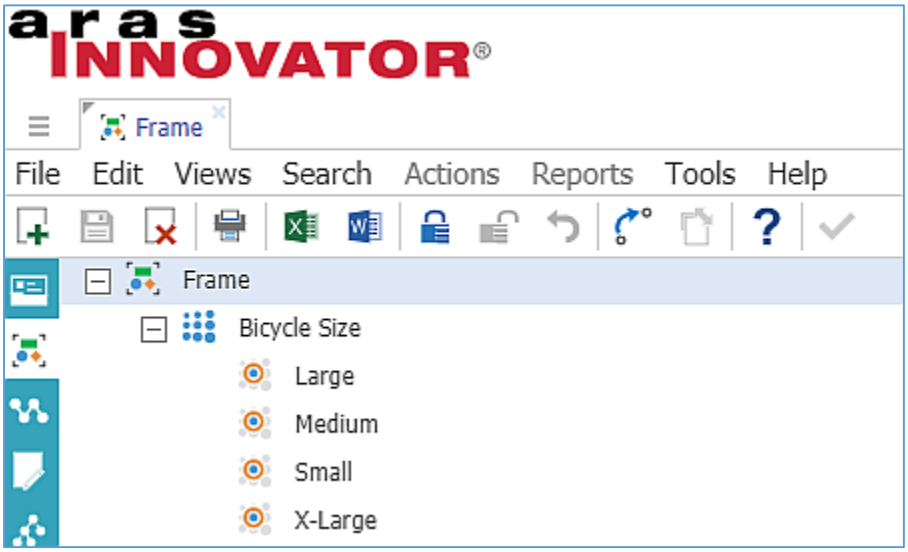


Figure 13.

4.6 Removing a Family from a Generic item

To remove an unused Family from a Generic Item, use the following procedure:

1. Right click on a Family in the Generic Structure and select **Unpick** from the context menu:

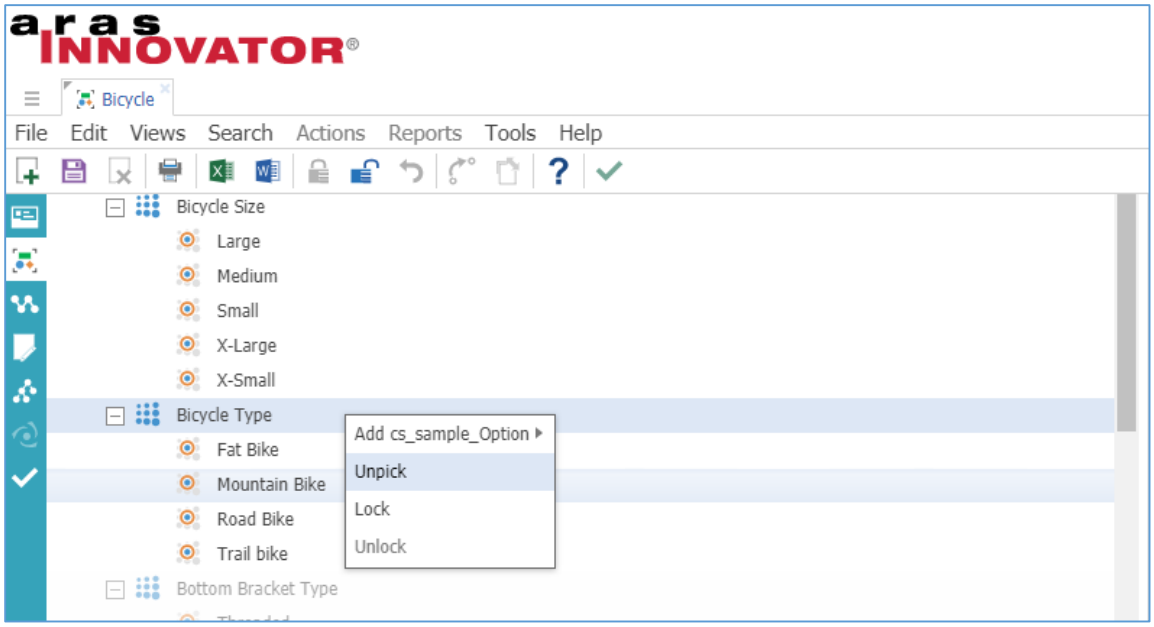


Figure 14.

The Family and its associated Options are grayed out and a red X appears on the right.

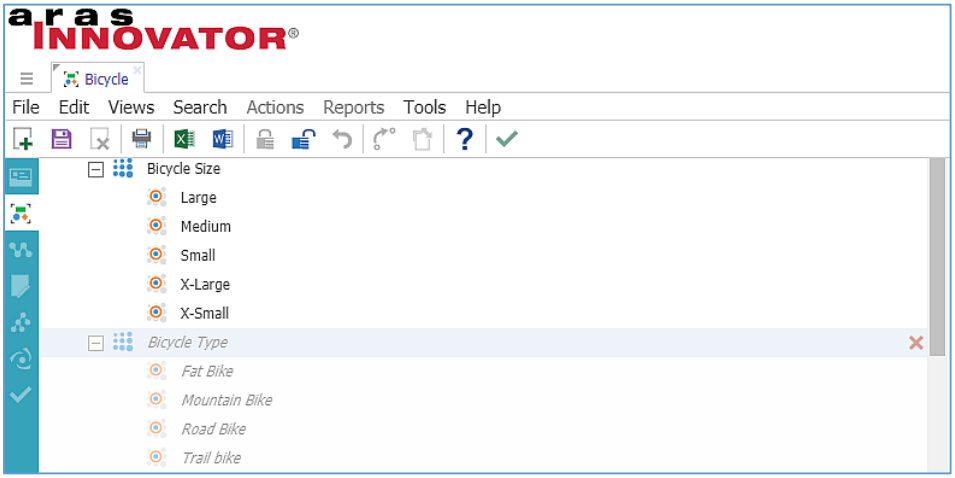


Figure 15.

2. Click **Save** to remove the Family completely from the structure.

4.7 Creating a Generic Structure

You can create Generic Structures to manage configurable structures with fixed and variable content. The Usages tab, where Technical Solutions are related, is disabled for Generic Items with a structure because they are not leaf-level Generic Items. Technical Solutions related to the leaf-level Generic Item, e.g. Part, can have its own multi-level Part BOM structure.

Use the following procedure to create a Generic Structure:

1. Select **Configurator>Generic Item** from the TOC. The Generic Item search screen appears.

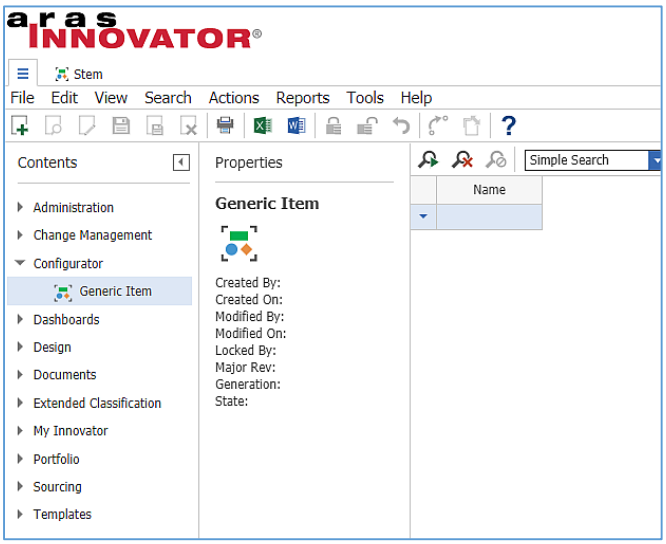


Figure 16.

2. Click **Create a New Icon**. The Generic Item screen appears.

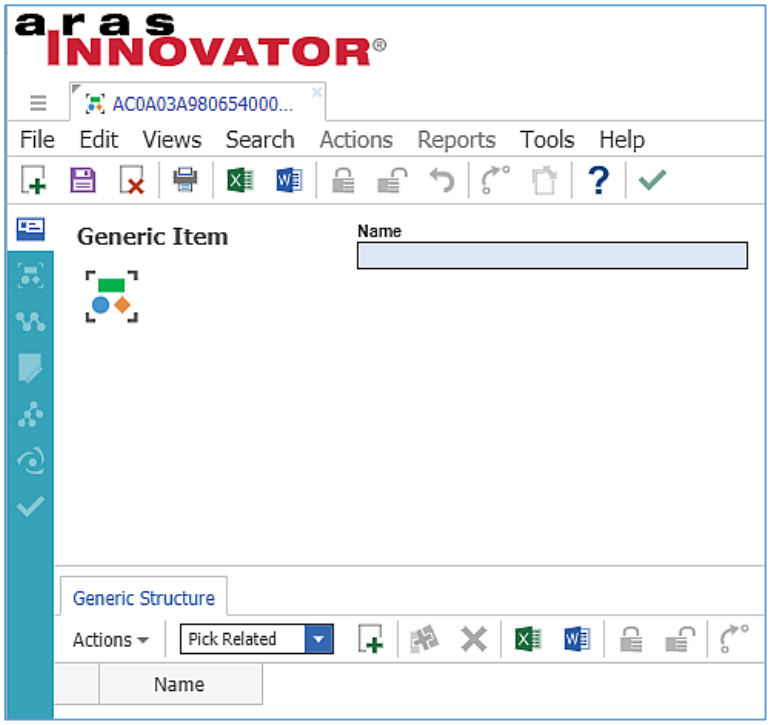


Figure 17.

3. Enter a name for the item in the **Name** field and click **Save**.

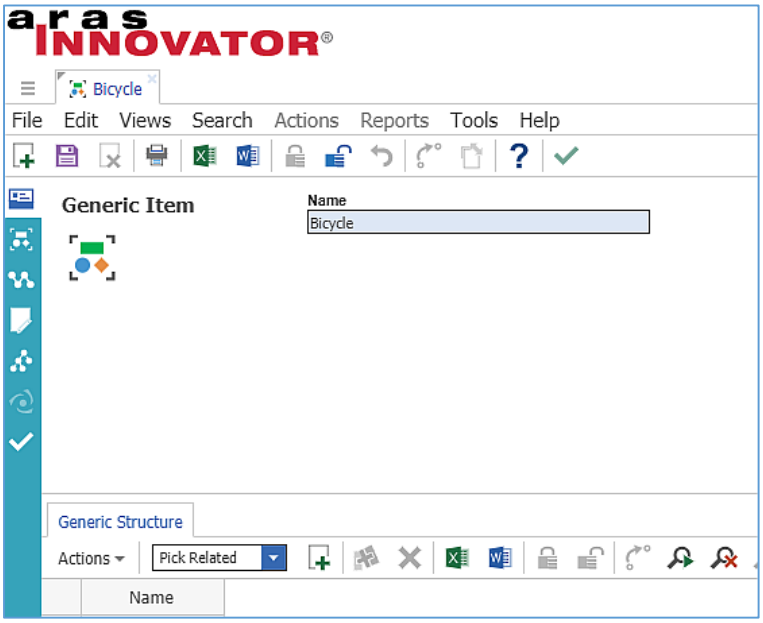


Figure 18.

4. Click the **New Relationship** icon on the Generic Structure tab to add Generic Items to the structure. The Search dialog appears.

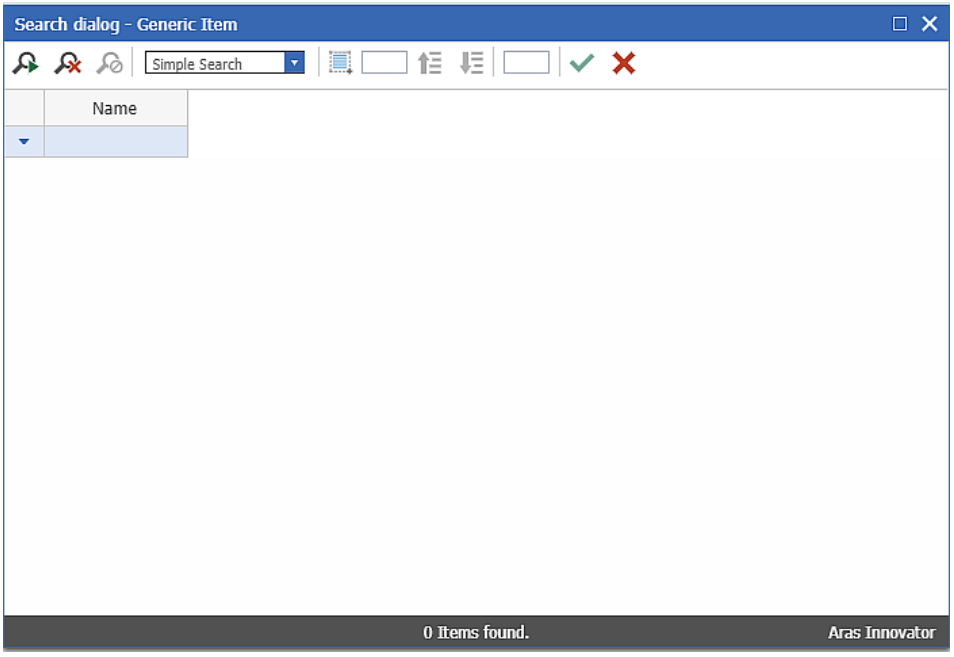


Figure 19.

5. Click the **Search** icon to see a list of available Generic Items.

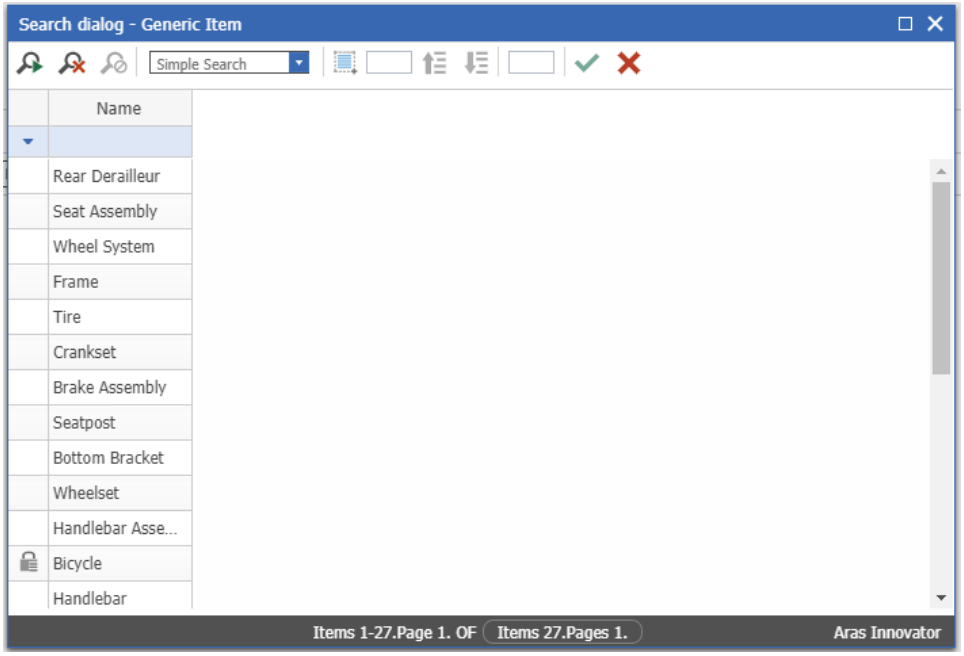


Figure 20.

6. Highlight the items that you want to add to the Generic Structure and click the green checkmark. The items appear on the Generic Structure tab.

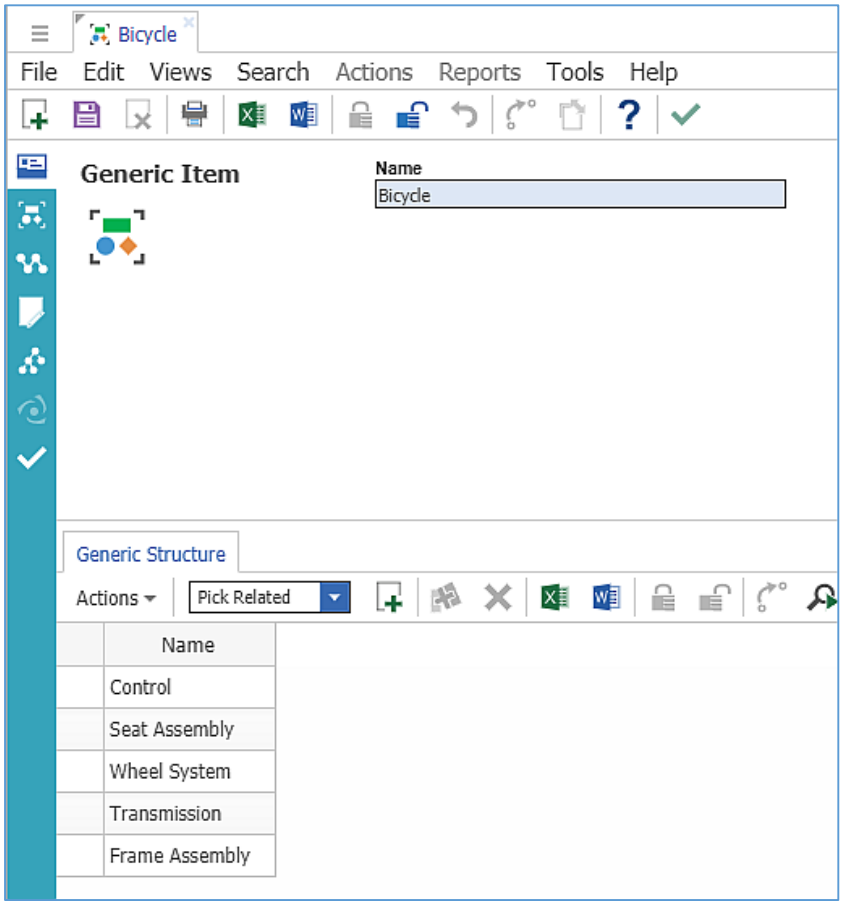


Figure 21.

The Usages icon is disabled because the Generic Item, Bicycle, has a structure. Thus, it is not a leaf-level Generic Item.

7. Click the **Relevant Families** icon to see all the Families relevant to the structure.

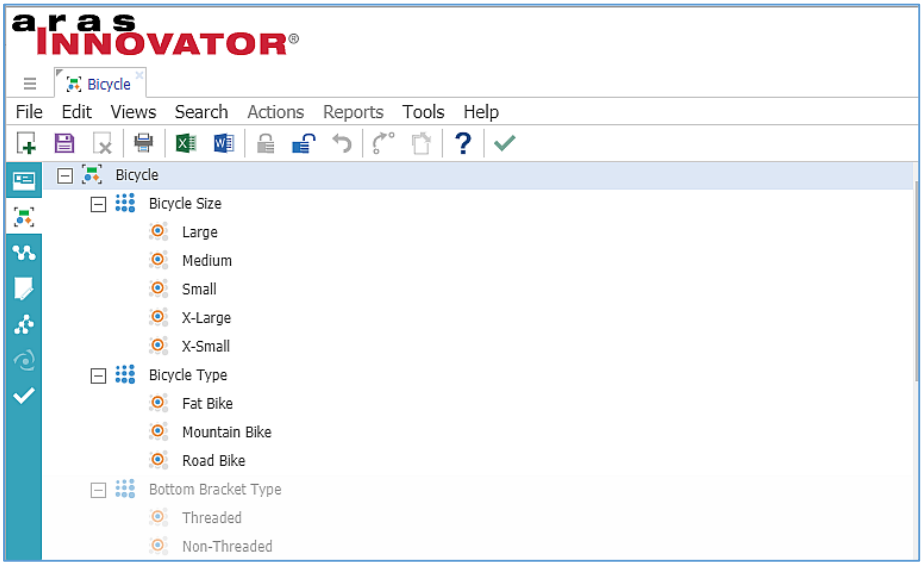


Figure 22.

Family and Option names that appear in black text are directly attached to the Generic Item in context. Family and Option names that are grayed out are attached to other Generic Items within the structure. For example, the Bicycle Size family is related to the Bicycle Generic Item. The Bottom Bracket Type family is a related to Bottom Bracket generic item within Bicycle's multi-level Generic Structure.

4.8 Adding Rules to a Generic Structure

You create Rules within the Generic Structure to specify which Options across Families can and cannot go together. You can use either the Text Rule Editor or the Table Rule Editor to view, create, edit and delete rules

4.8.1 Using the Text Rule Editor

Use the following procedure:

1. Open a Generic Item, and click the **Text Rule Editor**  icon in the sidebar. A list of existing Rules appears:

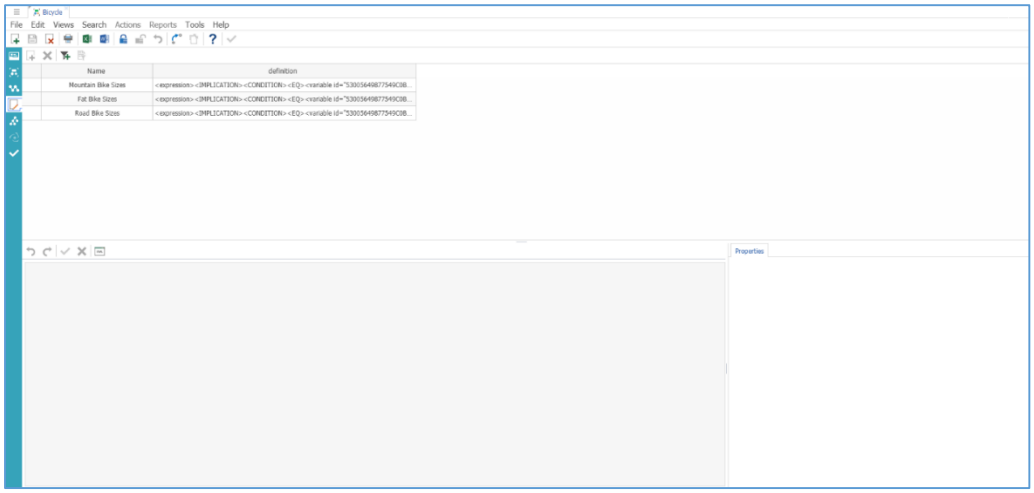


Figure 23.

2. Select a Rule from the grid. Its rule definition is displayed in the expression editor.

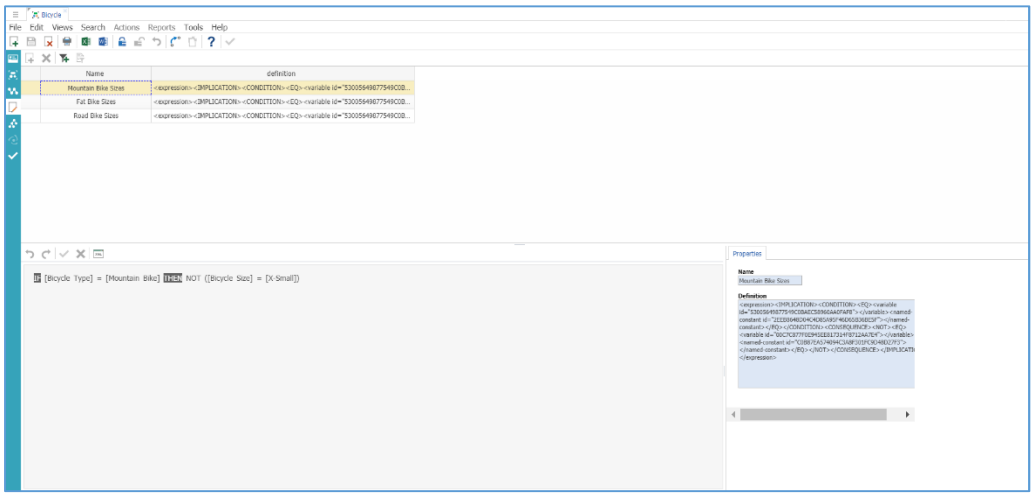


Figure 24.

3. To edit the Rule, lock the Generic Item. In the expression editor, node and value suggestions are provided. Suggested Families are the Relevant Families associated with the Generic Item in context and all Generic Items within its multi-level Generic Structure. Suggested values are the Options from the selected Family.

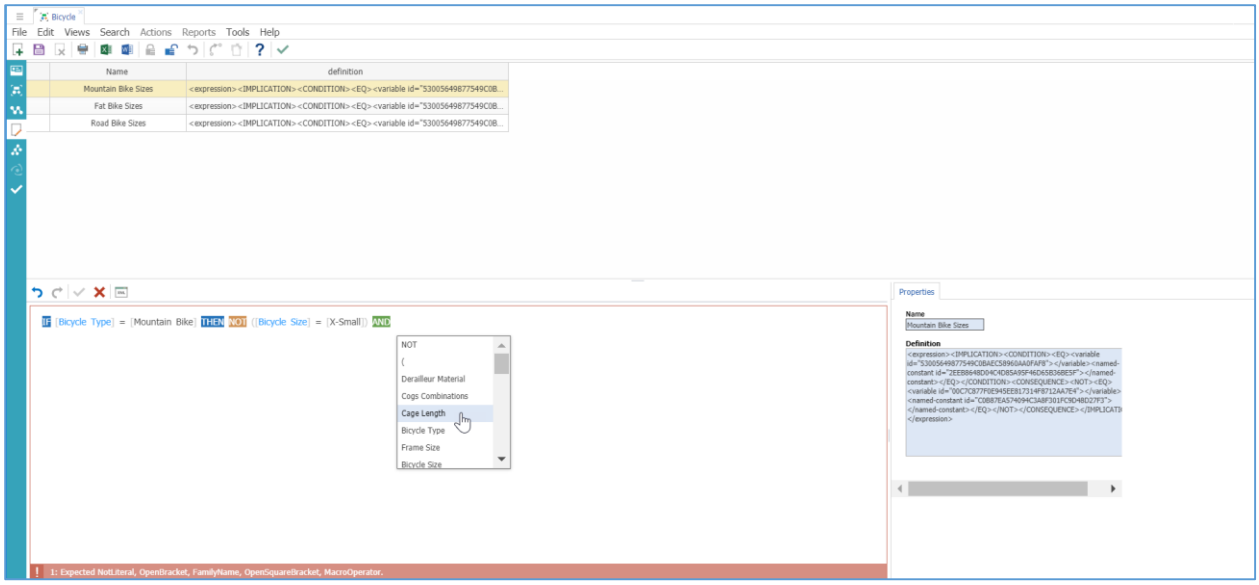


Figure 25.

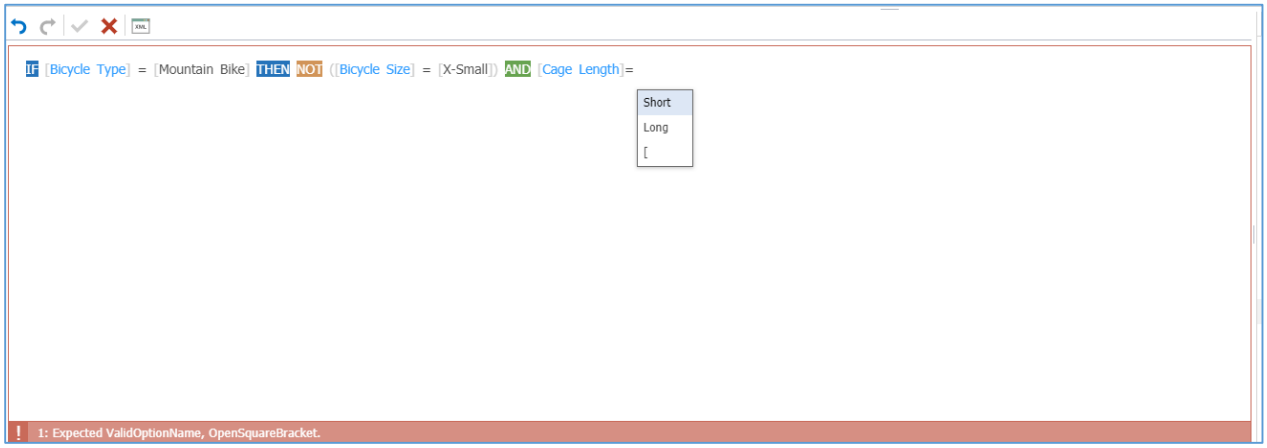


Figure 26.

The Properties tab displays the Boolean expression definition of the rule:

```
<expression>
   <IMPLICATION>
      <CONDITION><EQ><variable
id="53005649877549C0BAEC58960AA0FAF8"></variable><named-constant
id="2EEB8648D04C4D85A95F46D65B36BE5F"></named-
constant></EQ></CONDITION>
      <CONSEQUENCE><NOT><EQ><variable
id="00C7C877F0E945EE817314F8712AA7E4"></variable><named-constant
id="C0B87EA574094C3A8F301FC9D48D27F3"></named-
constant></EQ></NOT></CONSEQUENCE>
   </IMPLICATION>
</expression>
```

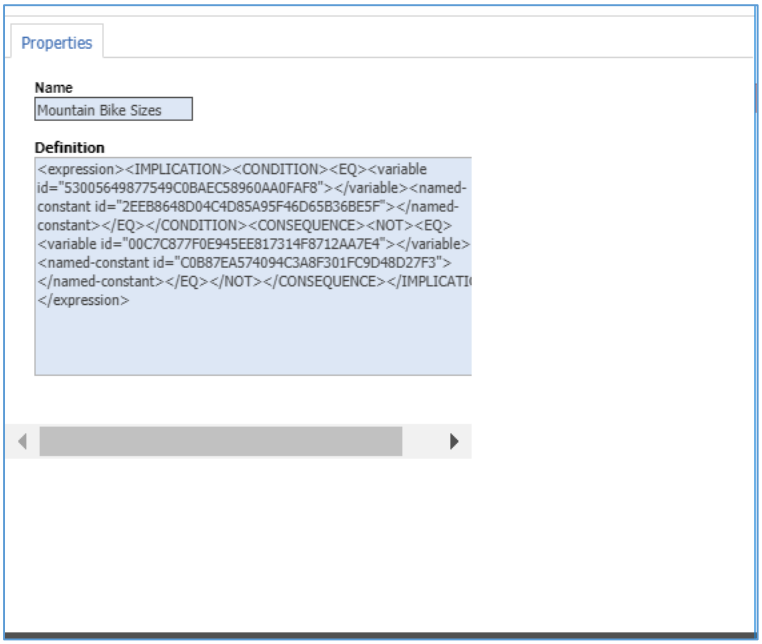
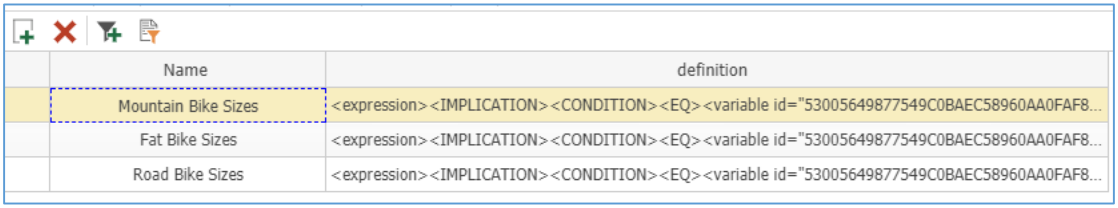


Figure 27.

4. Click on the **Create New** icon to create a new Rule. Click the **Delete** icon to delete an existing Rule. Choose **Set Filter** to filter out Rules by deselecting Families and/or Options in the Filter Settings dialog.



	Name	definition
	Mountain Bike Sizes	<expression><IMPLICATION><CONDITION><EQ><variable id="53005649877549C0BAEC58960AA0FAF8...
	Fat Bike Sizes	<expression><IMPLICATION><CONDITION><EQ><variable id="53005649877549C0BAEC58960AA0FAF8...
	Road Bike Sizes	<expression><IMPLICATION><CONDITION><EQ><variable id="53005649877549C0BAEC58960AA0FAF8...

Figure 28.

When creating a new Rule, the Rule Expression Editor suggests nodes and values - similar to when editing an existing Rule. Define the Rule and provide a name.

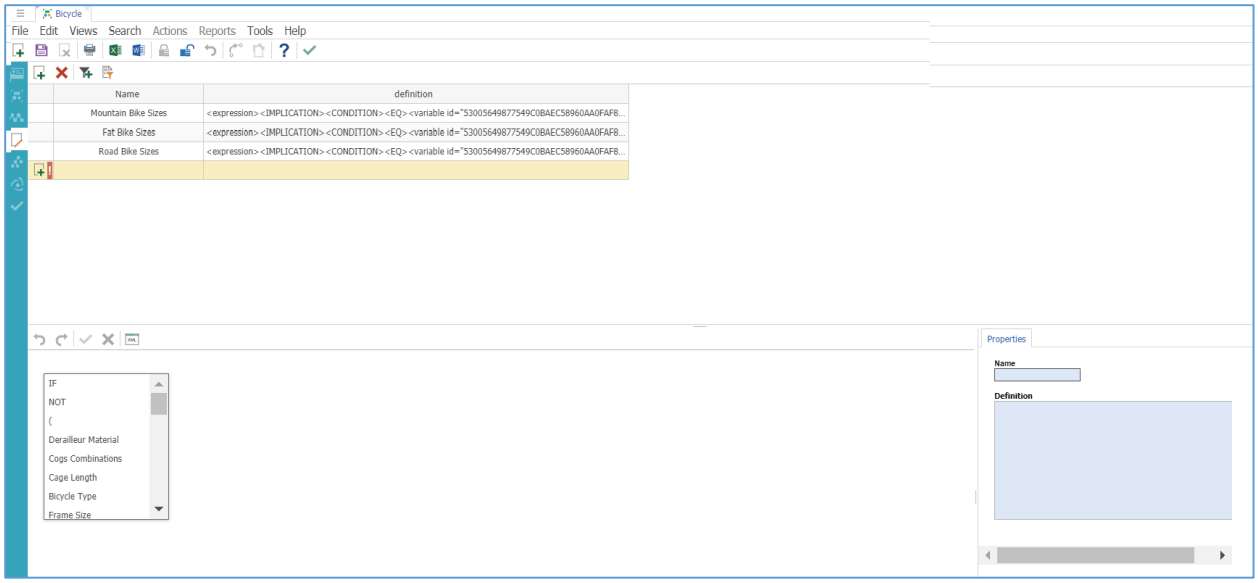


Figure 29.

4.8.2 Using the Table Rule Editor

The Table Rule Editor provides a graphic interface that you can use to view and create Rules:

1. Open a Generic Item. Click on the Table Rule Editor icon in the sidebar. This shows the Relevant Families in the scope and the existing Rules that fit the Table Rule Editor. Click on a Rule to see its rule expression.

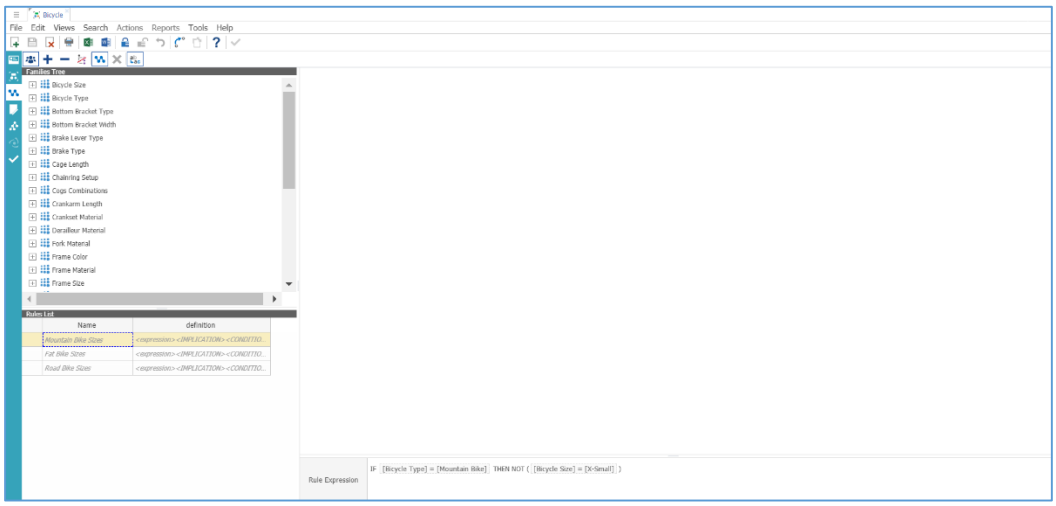


Figure 30.

2. Select Principal Groups P and Constraint Groups C to view the Rules in the table. "**I**" means that the intersecting option combination is included, i.e. allowed. "**E**" means the intersecting option combination is excluded, i.e. disallowed. If the cell in the table is blank, the intersecting option combination is implied as allowed.

3. The selected rule in the Rules List is highlighted in the table.

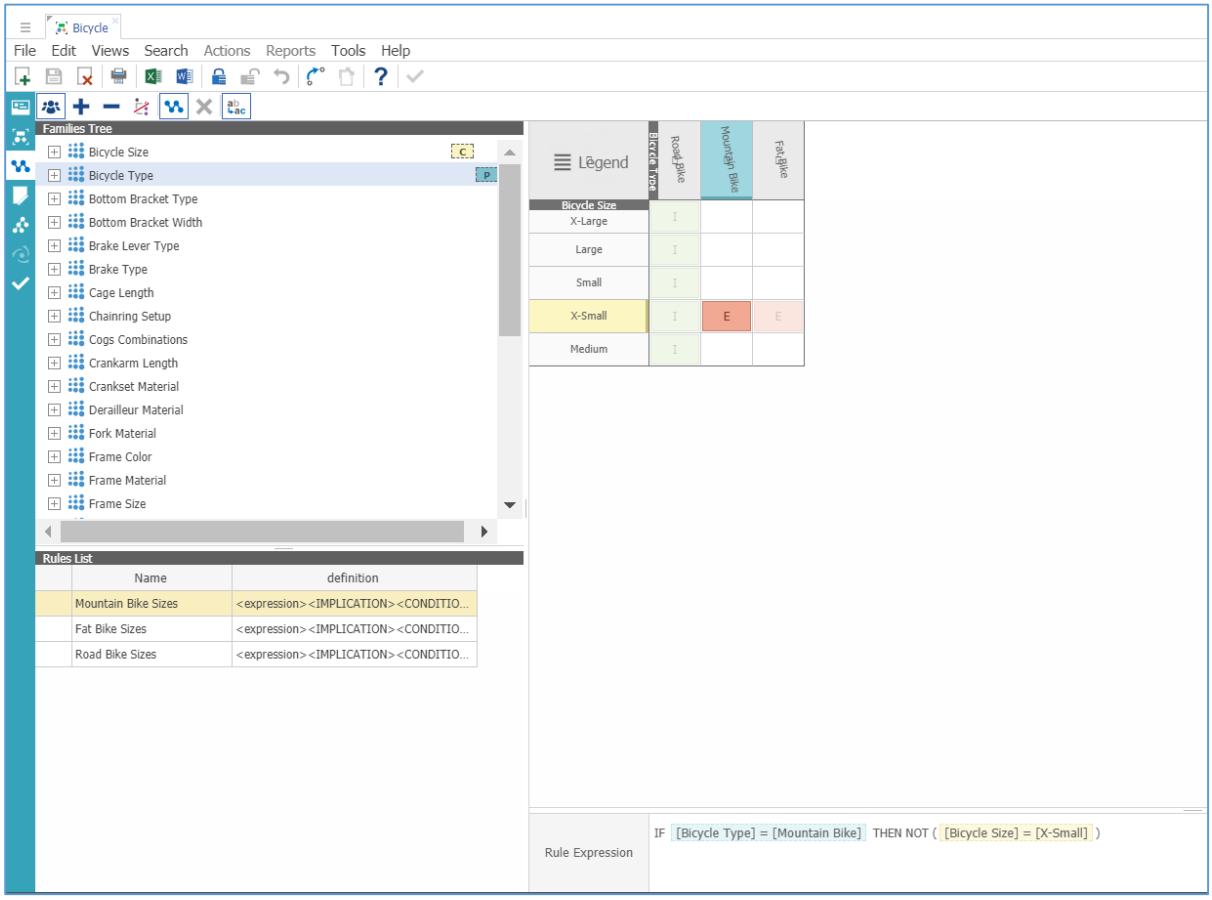


Figure 31.

4. To create a new Rule, lock the Generic Item. In the Families Tree, Families and Options in the scope are displayed. Choose the necessary Families or Options as the Principal Group (for the Condition part of the Rule), and another set of Families or Options as the Constraint Group (for the Consequence part of the Rule). In the table, select from Include or Exclude choices to create Rules. Create as many Rules as needed. Save and Unlock the Generic Item.

In below figure, if “I” (Include) is selected for at the Mountain Bike P and Aluminum Alloy C intersection cell on the table, the following rule expression is constructed:

IF [Bicycle Type] = [Mountain Bike] THEN [Frame Material] = [Aluminum Alloy]

If, instead of “I”, “E” (Exclude) is selected, the following rule expression is constructed:

IF [Bicycle Type] = [Mountain Bike] THEN NOT [Frame Material] = [Stainless Steel]

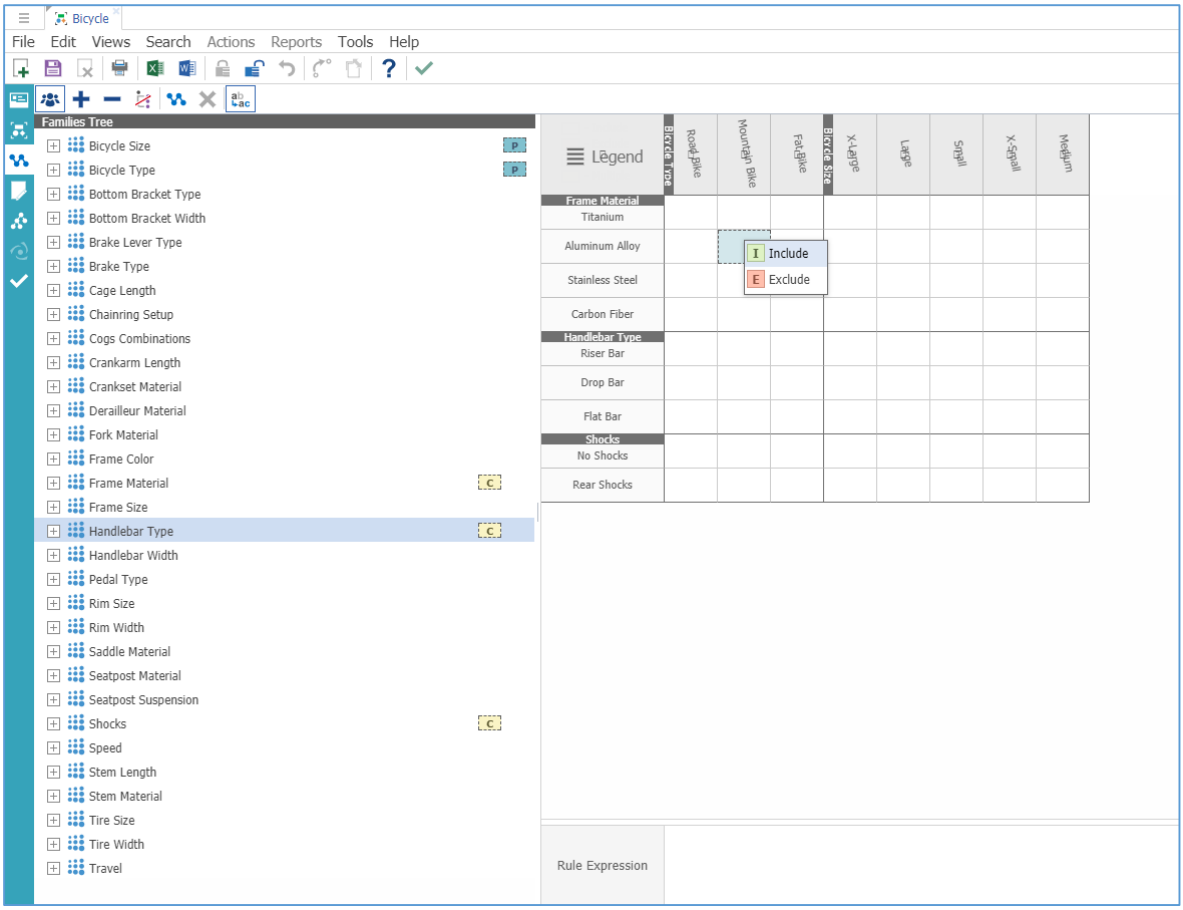


Figure 32.

4.9 Adding Technical Solutions for a Leaf Generic Item

Technical solutions, e.g. Part in this Sample Application, are related to the leaf level for the generic structure. The technical solutions can have their own structure. For example, related Part can have its multi-level Part BOM structure.

4.9.1 Variable Content

Variable content means that the generic item has variability, and it has several related technical solutions, each for a different set of option combinations.

For example, on a bicycle generic structure, frame that has variability:

For *[Frame Color] = Silver AND [Frame Size] = 50cm AND [Frame Material] = [Carbon Fiber]* option combination, frame Part Number *FR-4493* will be used.

For *[Frame Color] = Orange AND [Frame Size] = 42cm AND [Frame Material] = [Aluminum Alloy]* option combination, frame Part Number *FR-4856* will be used.

Use the following procedure to add a Technical Solution to a Leaf Generic Item that contains variable content:

1. Open a Generic Item that has variability. Note that there is no “Generic Structure” tab within the “Form of Generic Item”. It is because this is a leaf level generic item within the generic structure, and does not have any child generic items of its own. Also note that the Usages icon  is available.

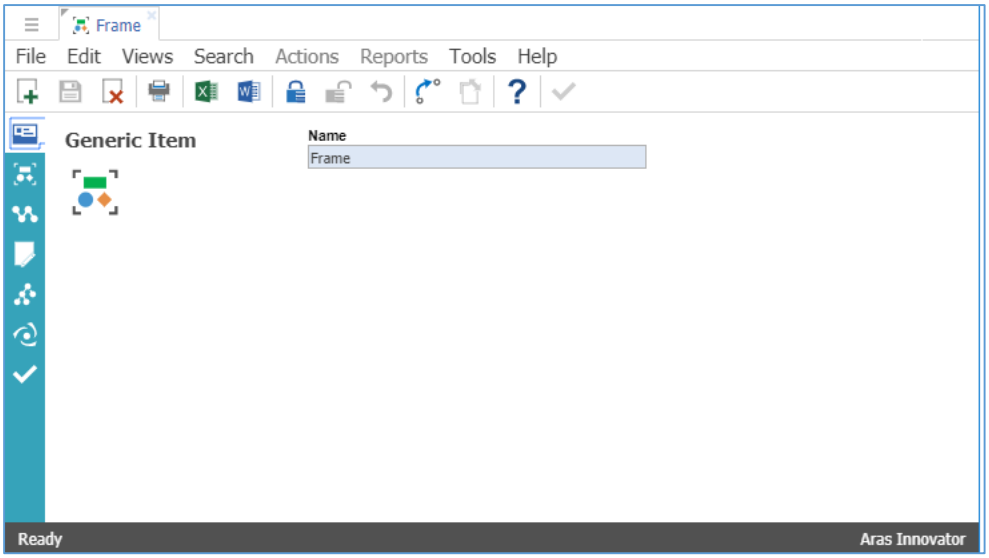


Figure 33.

2. Click on Usages icon  on the sidebar. A list of associated Parts with corresponding usage conditions are displayed. When a row is selected, the condition and Part number are displayed at the bottom of the page.

   The condition can contain one or more families combined with AND and/or OR Boolean operator. For example, the condition can be:

   [Frame Size]=[46.5cm]

   [Frame Size]=[46.5cm] OR [Frame Size]=[50cm]

   [Frame Size]=[46.5cm] AND [Frame Material]=[Titanium] AND [Frame Color]=[Orange]

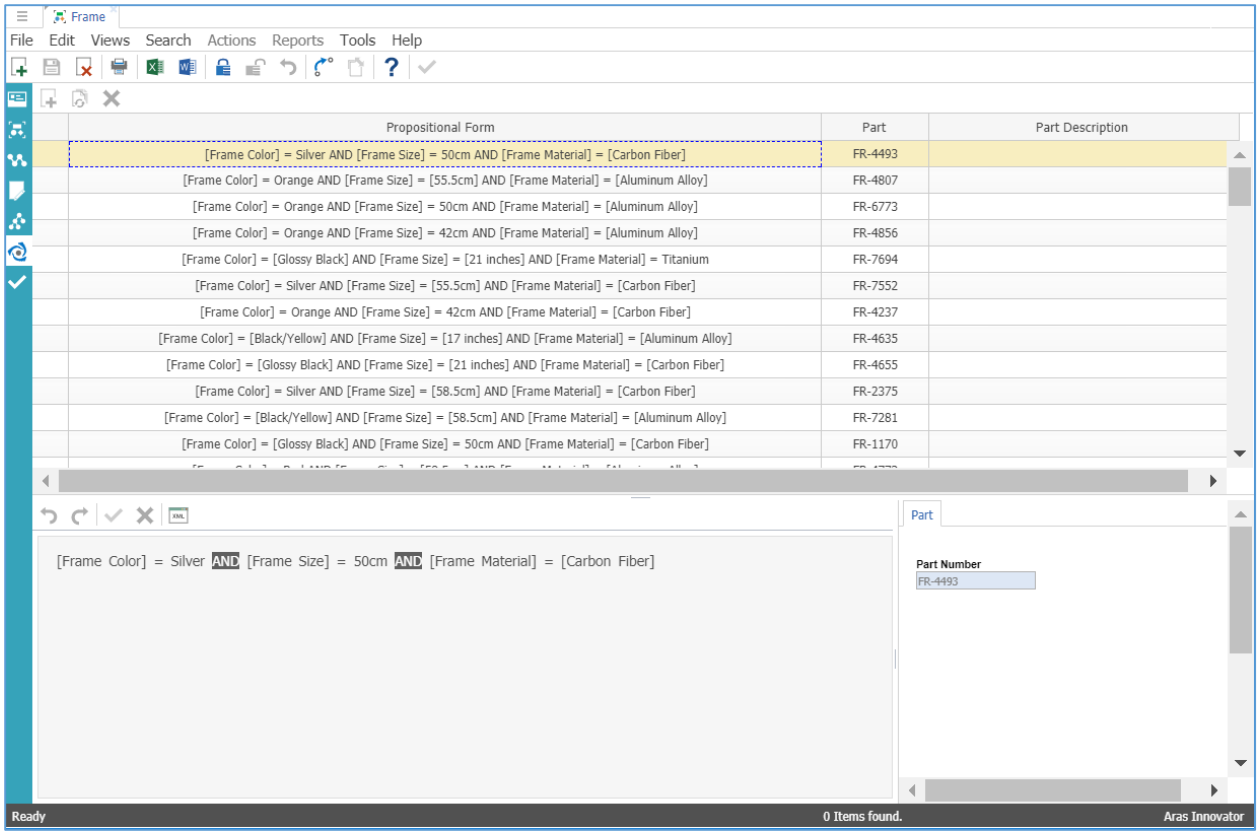


Figure 34.

3. To associate a new part, click the **Pick New** icon  . The Search dialog box appears. Enter the search criteria and search for parts:

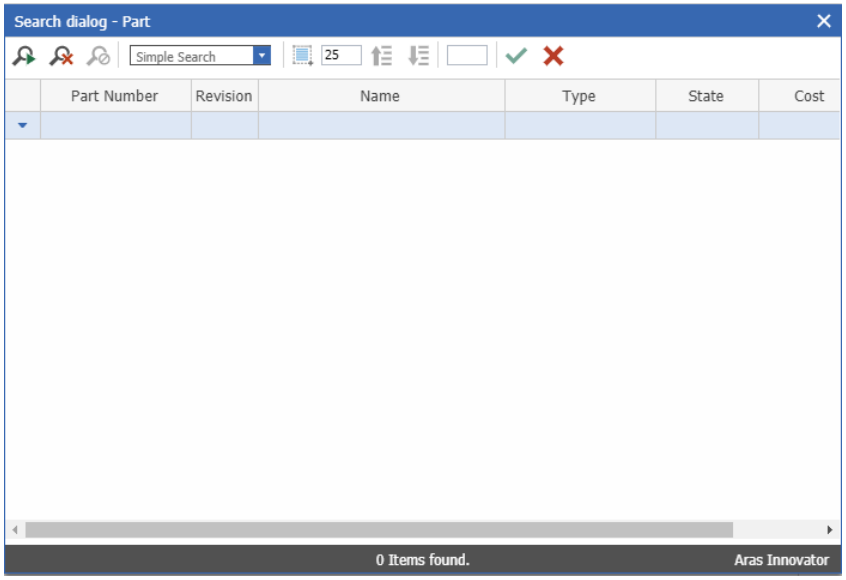


Figure 35.

4. Select one or more parts from the search results, and click ✓ to add the part to the generic item:

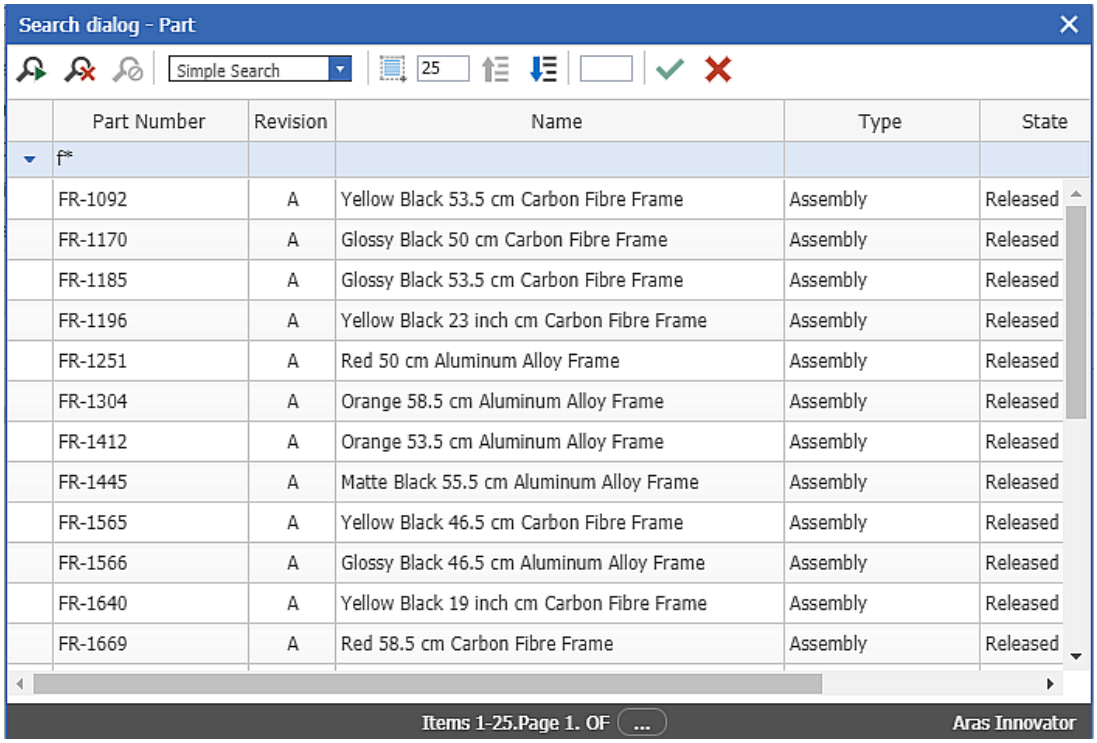


Figure 36.

5. Scroll down on the table, as needed. For each selected part, a new row is added at the bottom of the table. Select the new row to enter its usage condition.

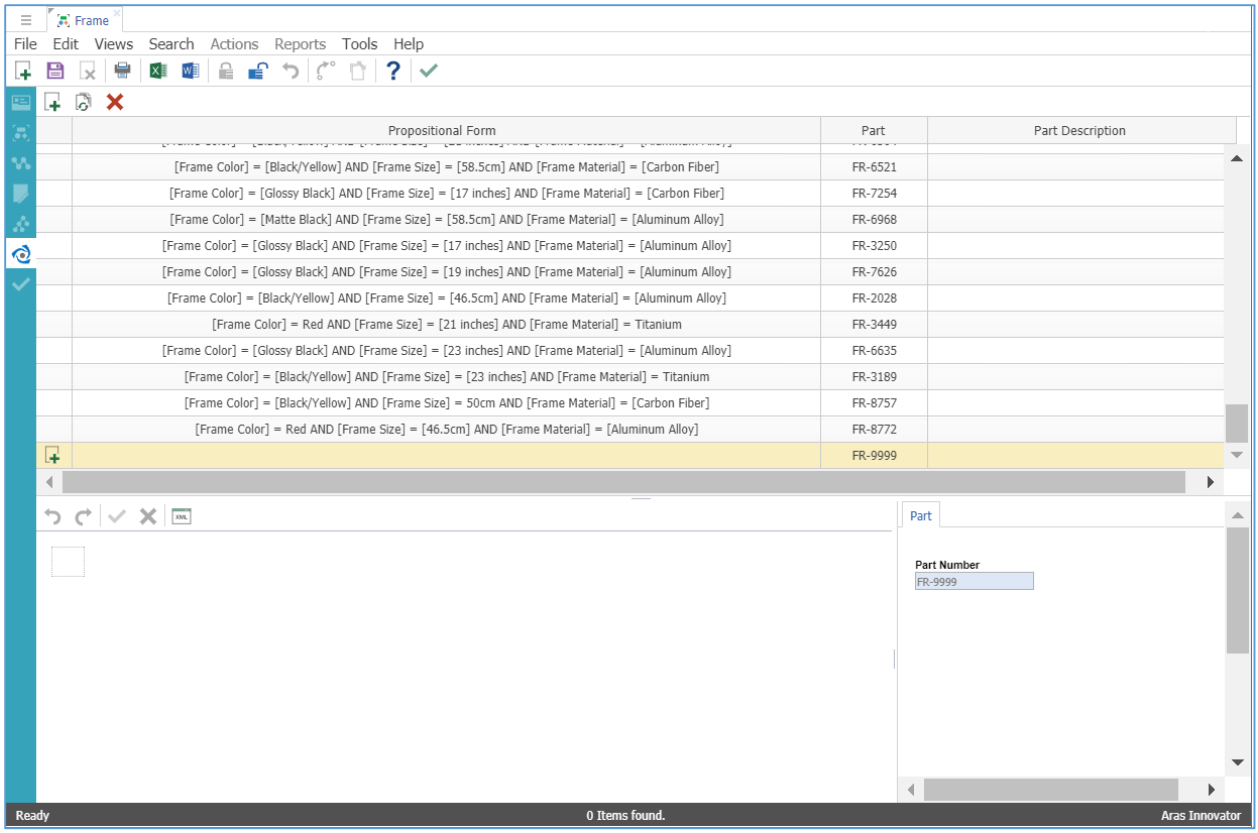


Figure 37.

6. Click into the **Enter Usage Condition Expression** box at the bottom of the window to enter the usage expression for the part. Suggestions are provided to construct the condition. Suggested families are the relevant families associated with generic items within the scope.

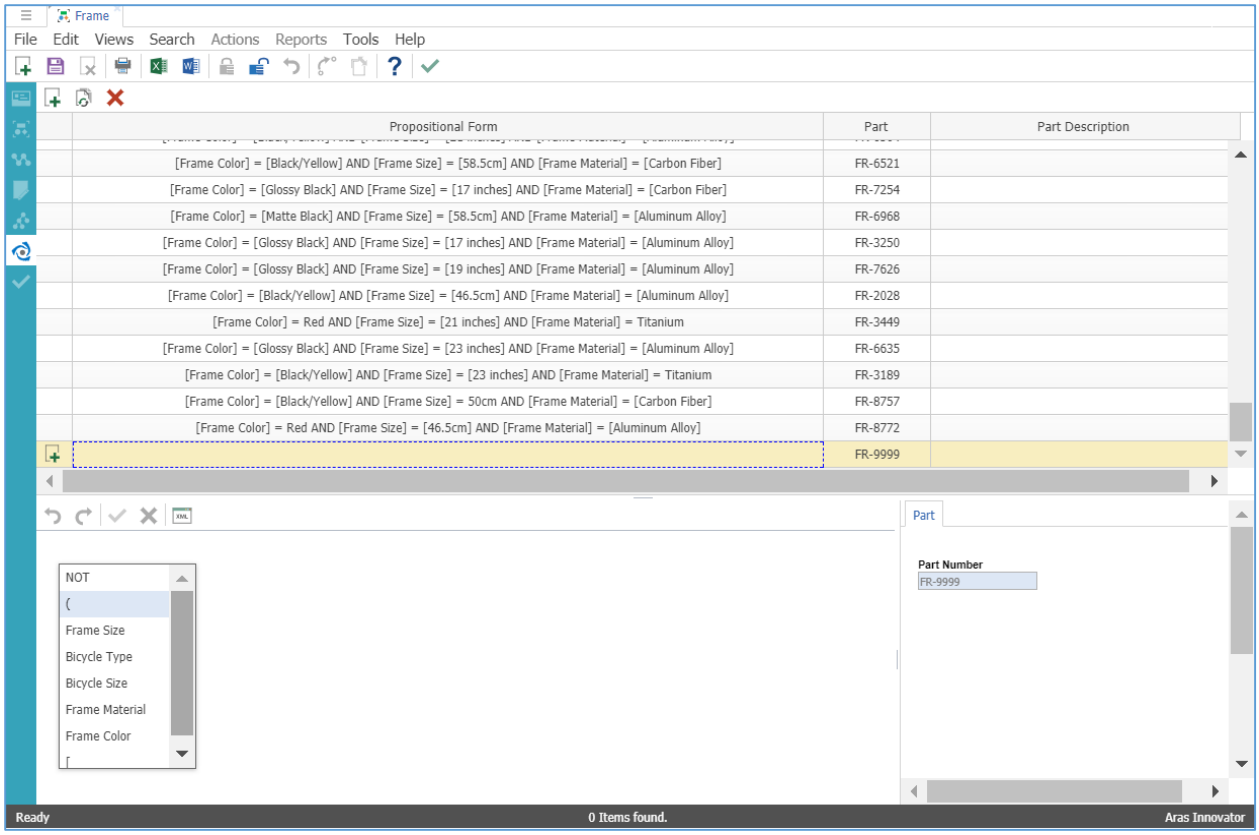


Figure 38.

7. Construct the usage condition. When the expression is valid, the usage condition gets displayed in the Propositional Form column.

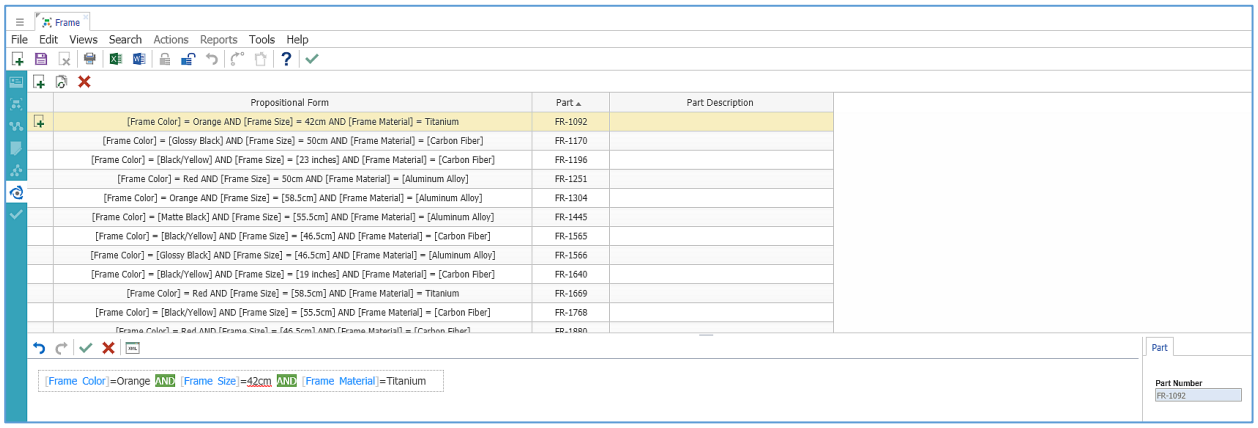


Figure 39.

8. If more than one part was added from search results, repeat the steps for each part to add its usage condition. Select a row and click ✕ if the part is not used. Save the generic item.

4.9.2 Fixed Content

Fixed content is common to all product variants in the generic structure. When the generic structure is resolved for option selections, the fixed content is always included and displayed regardless of the selections.

The procedure for adding a Part to a Leaf Generic Item for fixed content is the same as the procedure described in the previous section for Variable Content. The difference is that the usage condition will be left blank for the fixed part. An empty cell will be displayed in the “Propositional Form” cell of the corresponding row on the table.

4.10 Updating Usage Conditions for Technical Solutions on Leaf Generic Items

There are cases where you may need to change the usage conditions for a Leaf Generic Item. Use the following procedure:

1. Open the Generic Item, and click Usages  . The list of associated parts with their usage conditions are displayed.

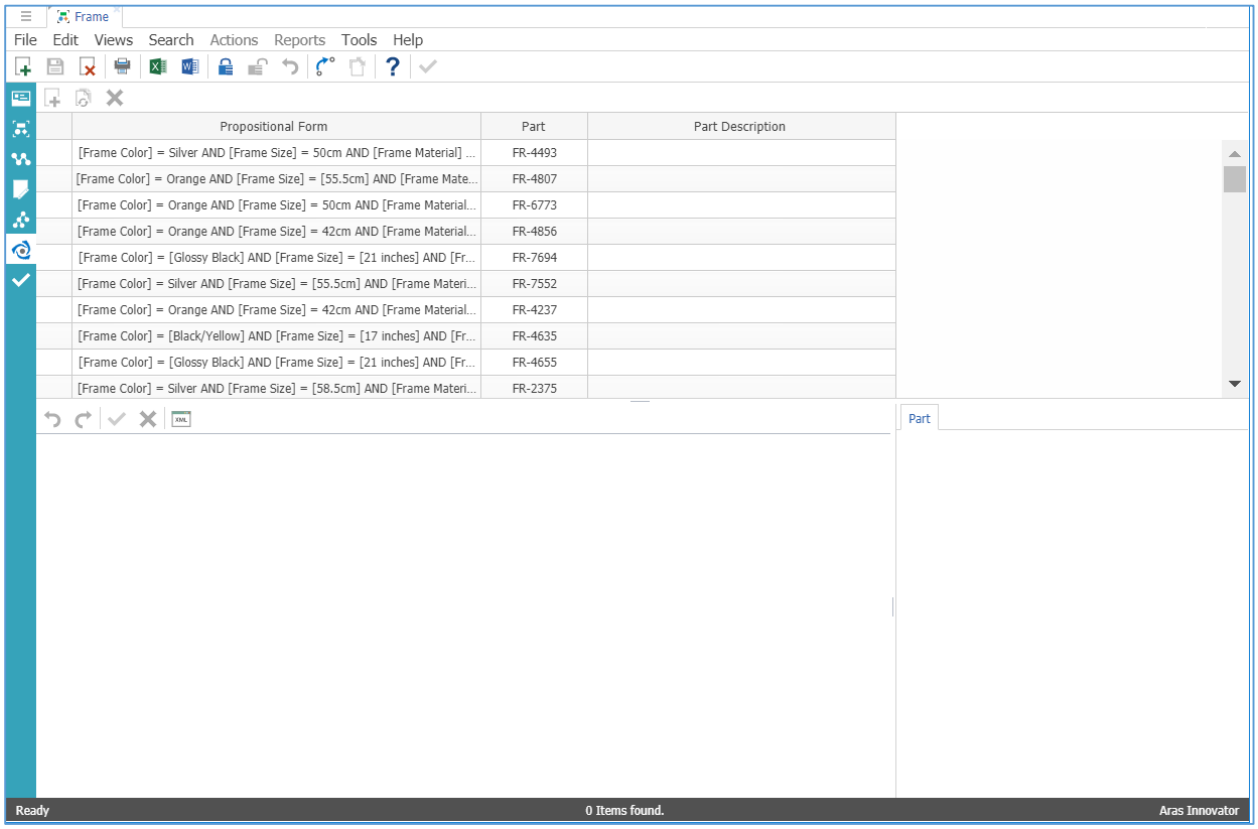


Figure 40.

2. Lock the Generic Item. Click on the row to update the usage condition. The condition appears in the Usage Condition Expression section of the screen:

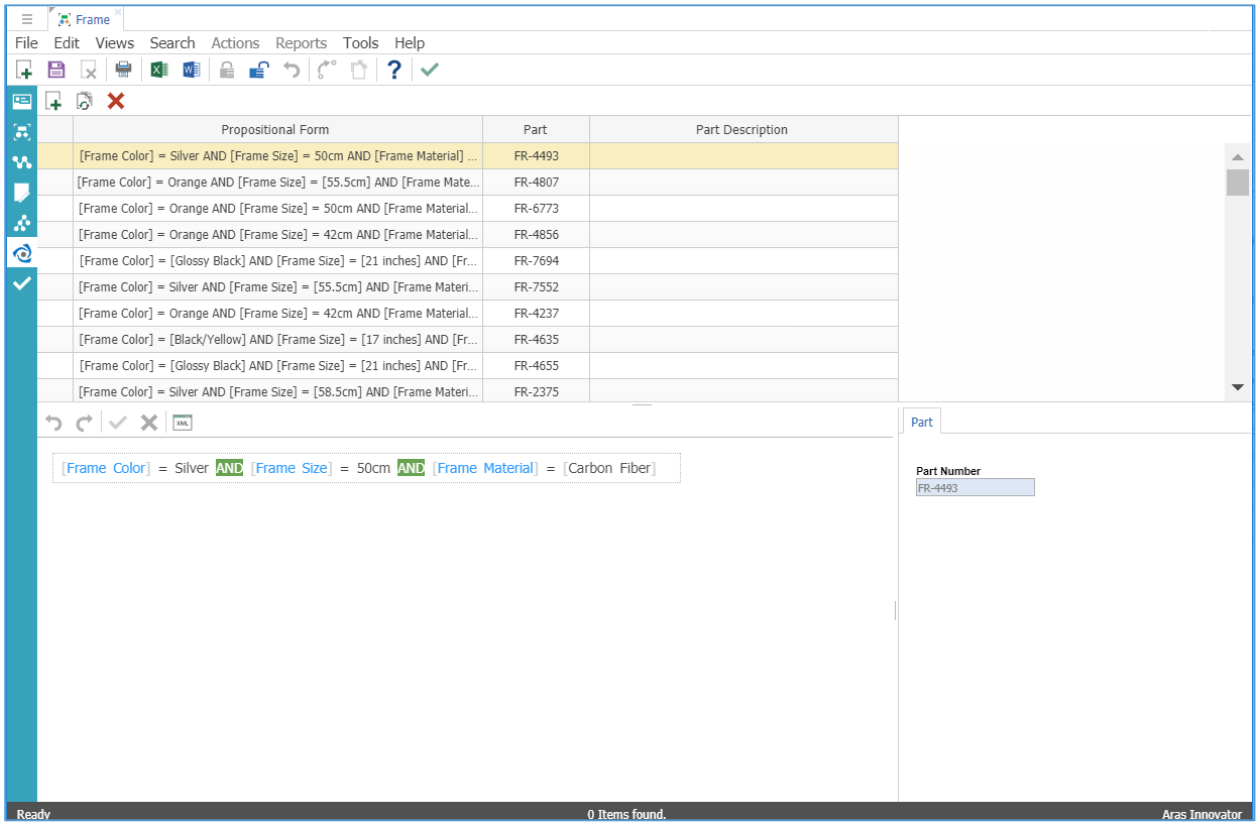


Figure 41.

3. Make necessary updates to the usage condition, such as appending to or removing from the existing usage condition. Click Save.

4.11 Removing a Technical Solution from a Leaf Generic Item

There are cases where you may need to remove a Technical Solution from a Leaf Generic Item. Use the following procedure:

1. Open the Generic Item, and click Usages  in the sidebar. The list of associated parts with their usage conditions are displayed.

2. Lock the Generic Item to update it. Select the row corresponding to the part on the table. Click on Delete button  on the table.  appears on the row.

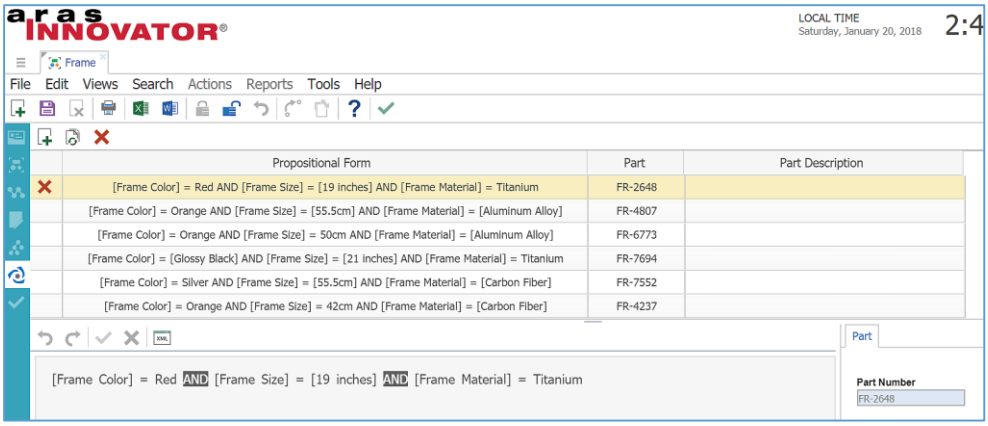


Figure 42.

3. Click Save to complete removing Part from the Generic Item.

4.12 Replacing a Technical Solution on a Leaf Generic Item

There are cases where you may need to replace a Technical Solution on a Leaf Generic Item for an existing usage condition. Use the following procedure:

1. Open the Generic Item, and click Usages  in the sidebar. The list of associated parts with their usage conditions are displayed.
2. Lock the Generic Item to update it. Select the row corresponding to the part on the table. Click on Replace Item button  on the table.
3. On the Part search dialog, enter the search criteria. From search results, choose the Part to replace with. Click on  to replace the Part on the selected row.
4. Click Save to complete replacing Part for same usage condition on the Generic Item.

4.13 Variant Tree

A Variant Tree displays allowed option combination in a tree view for a scope. Use the following procedure to view the Variant Tree.

1. Select a Generic Item. This can be a Generic Item with a Generic Structure, or a leaf level Generic Item.
2. Click on the **Variant Tree** icon  in the sidebar. The Families and Options within the scope are displayed. You can select/de-select families and options to show in the Variant Tree, and change the order of Families for display. Click on **Apply settings** to view the Variant Tree.

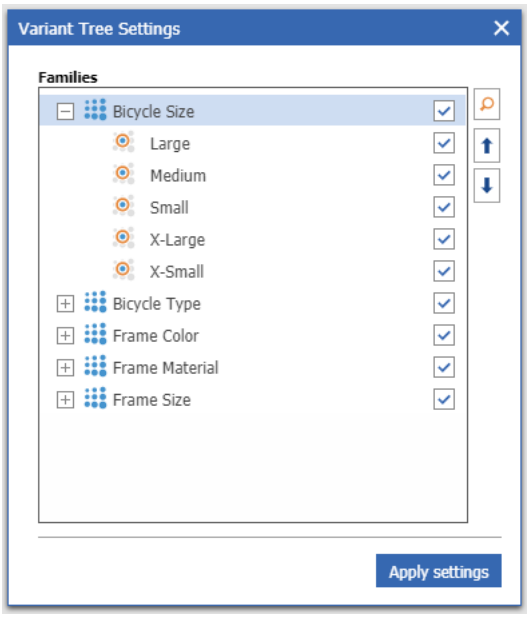


Figure 43.

3. Variant Tree and the number of valid combination count are displayed per the selections in **Variant Tree Settings**.

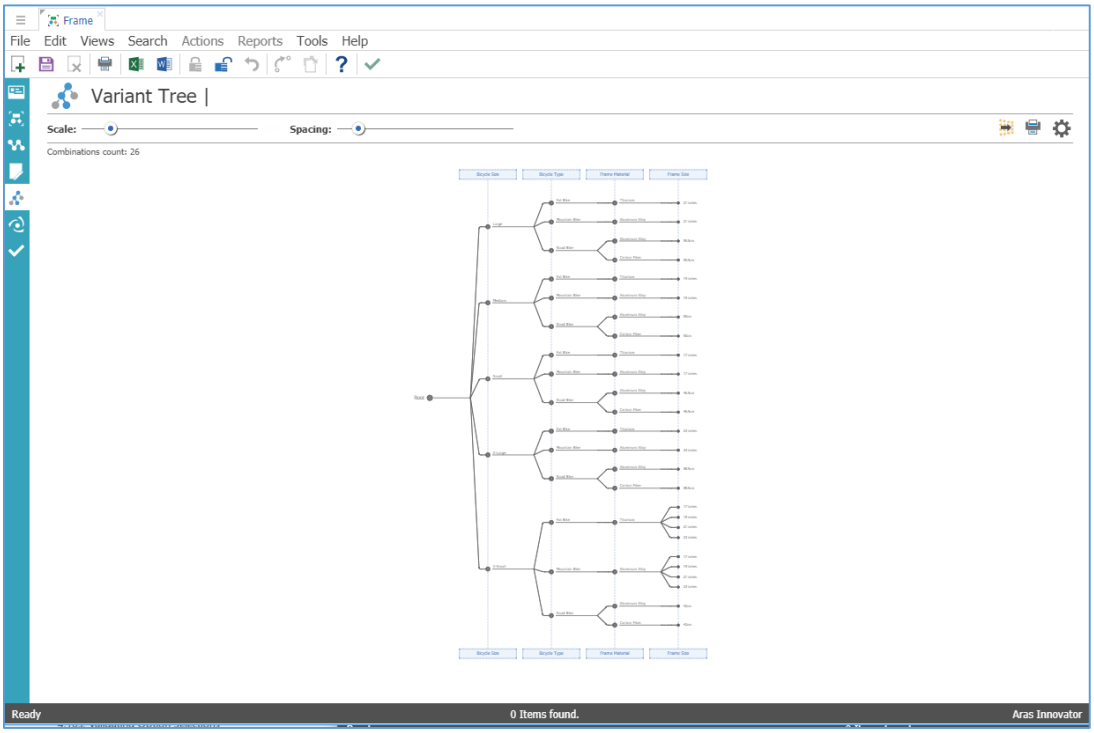


Figure 44.

4. In this view, you can scale up to zoom in, scale down to zoom out, increase or decrease spacing between branches.

5. To change the order of families, select a Family and drag it to the desired location. Alternatively, click to bring up **Variant Tree Settings** again.

6. In the Tree View, you can collapse and re-expand a branch. In below figure, “Large” option of branch of Bicycle Size Family has been collapsed.

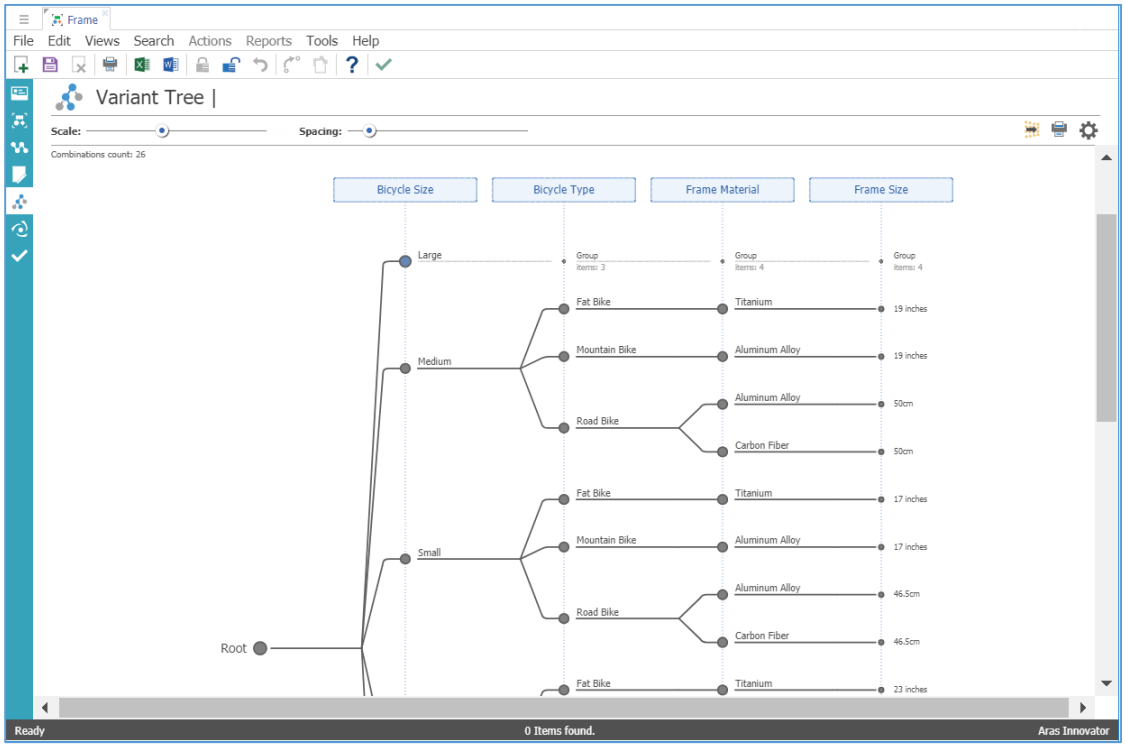


Figure 45.

7. Click the **Print** icon to print the Variant tree into a PDF file using the same Variant Tree settings as displayed in the UI. The PDF file is created and downloaded to your default download location.

8. Click on the **Export** icon to export the Variant Tree to an HTML file using the same Variant Tree settings as displayed in the UI. The HTML file is created and download to your default download location.

4.14 Validations and Structure Resolution

Click the **Validation and Resolution** icon from the sidebar.

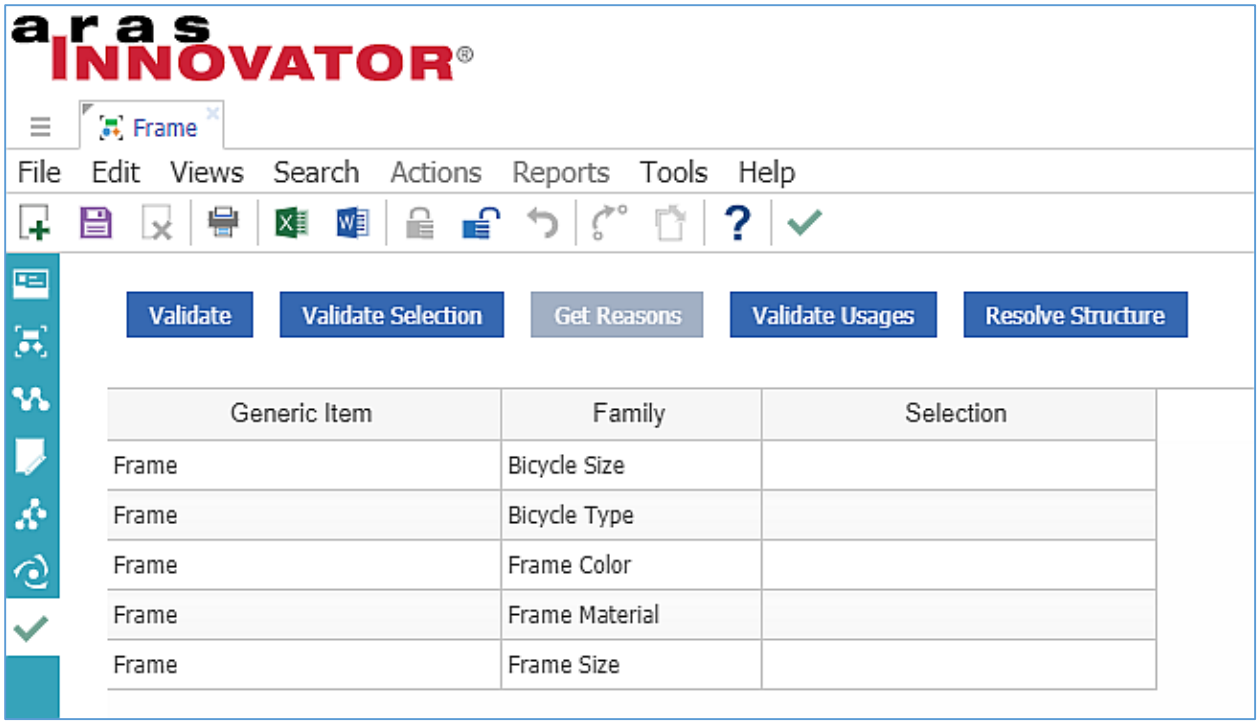


Figure 46.

Validate	Checks the Scope for the current Generic Item.
Validate Selection	Checks if option selections made in the grid are valid in the context of the Scope for the current Generic Item.
Get Reasons	Opens UI dialog with graphic representation of reasons that cause Scope be invalid for option selections made in the grid.
Validate Usages	Checks all leaf level Generic Items in the scope for missing and multiple part usages.
Resolve Structure	Resolves current Generic Structure to Part BOM structure with the help of part usages based on the option selections made in the grid.

4.14.1 Validating a Generic Structure

This validation can be executed for a Generic Item that has a Generic Structure, or a leaf level Generic Item.

Use the following procedure to validate a Generic Item:

1. Open a Generic Item, and click the **Validation and Resolution** icon in the sidebar.
2. To validate the Generic Item in context, click the **Validate** button without selecting any options in the grid.

If there are no validation errors, the following dialog box appears:

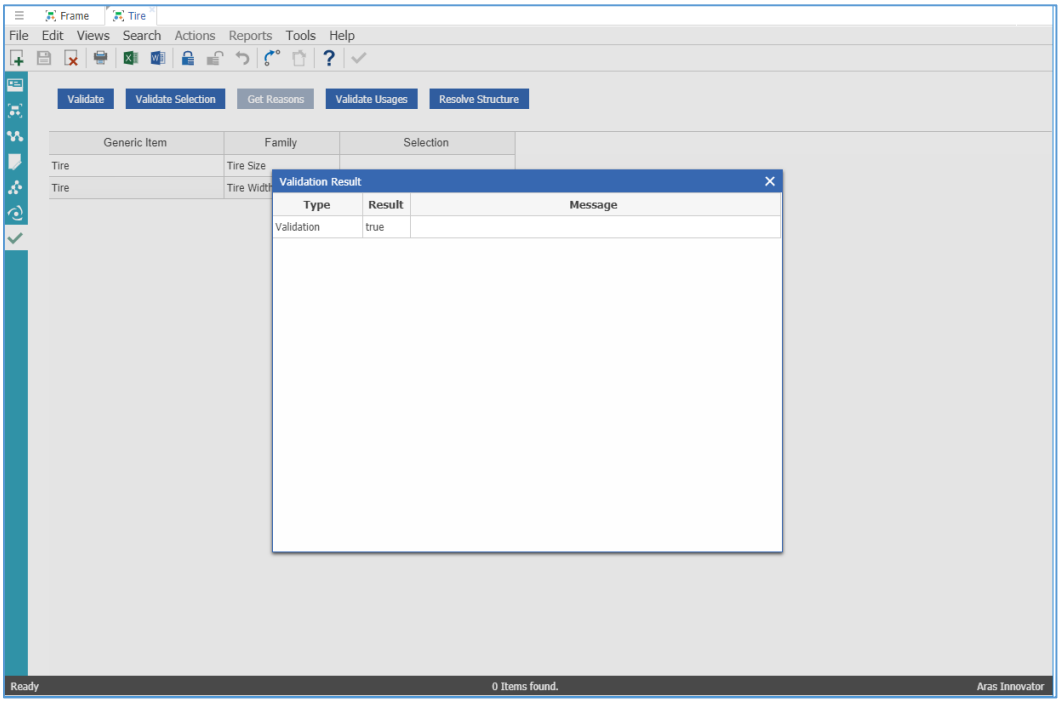


Figure 47.

If there are validation errors, they appear in the dialog box.

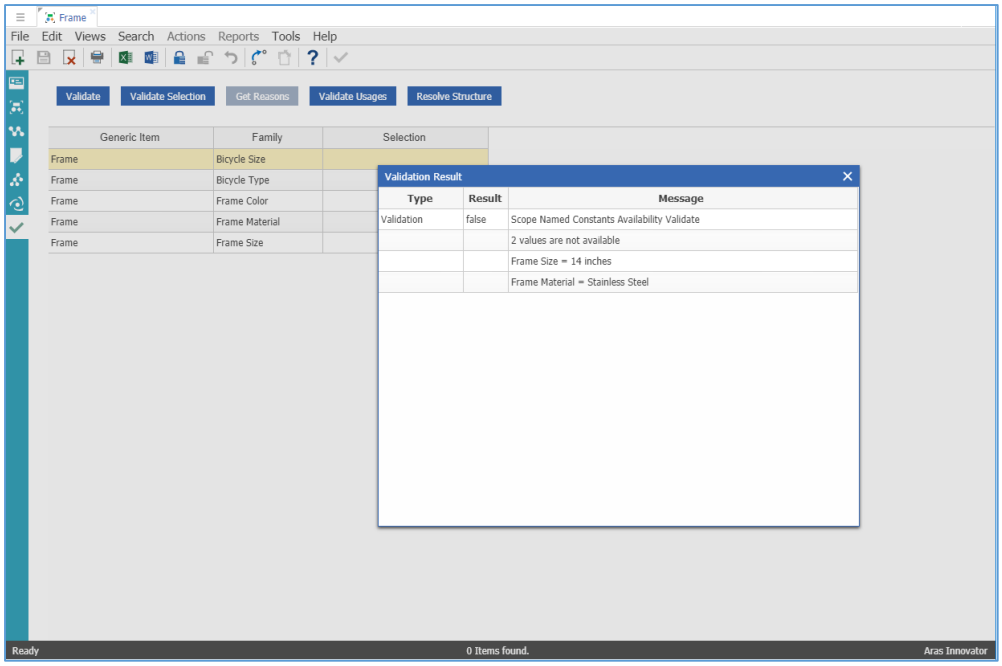


Figure 48.

In above example, the validation shows that neither Frame Size option of 14 inches nor Frame Material option of Stainless Steel can be selected for Frame Generic Item. There are rules in place that prevent selection of either of these two options.

4.14.2 Validating Option Selections

This validation can be executed for a Generic Item that has a Generic Structure, or a leaf level Generic Item.

Use the following procedure to validate option selections for a Generic Item.

1. Open a Generic Item, and click the **Validation and Resolution** icon in the sidebar.
2. Generic Items, Families and Options from the Scope of the current Generic Item are displayed in the grid. Valid options are displayed in black text, and invalid options are displayed in red text. As option selections are made, option availability of other families are determined.

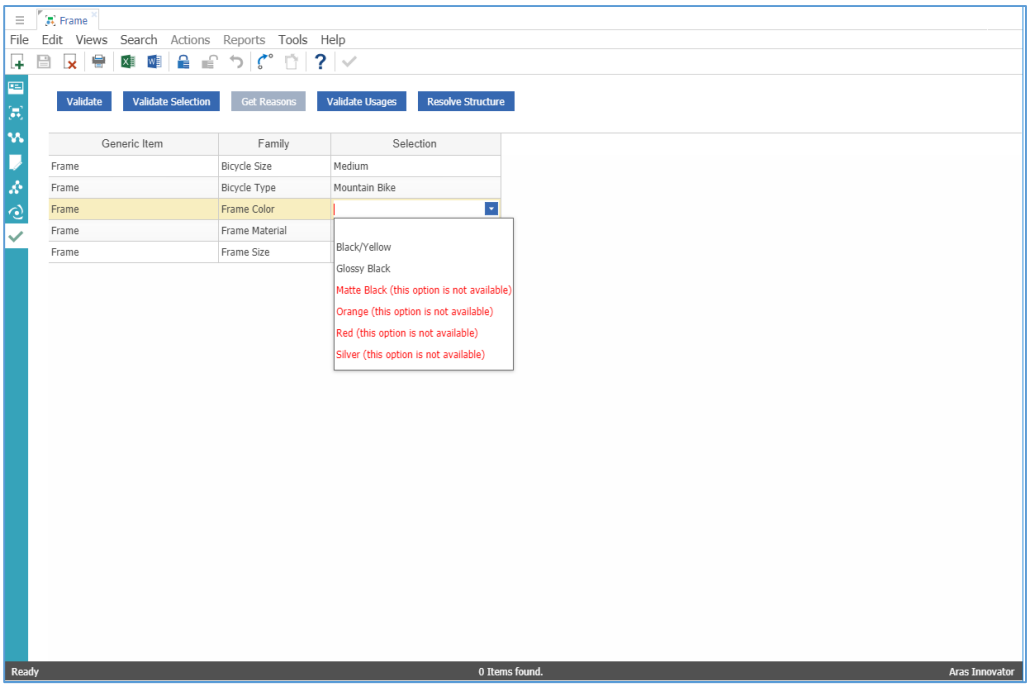


Figure 49.

3. Make the selections. This can be a complete or partial set of selections. A complete selection is when an option is selected on every row. A partial selection is when option selection is left blank on one or more rows.

   If a selection is invalid, Get Reasons button gets activated.

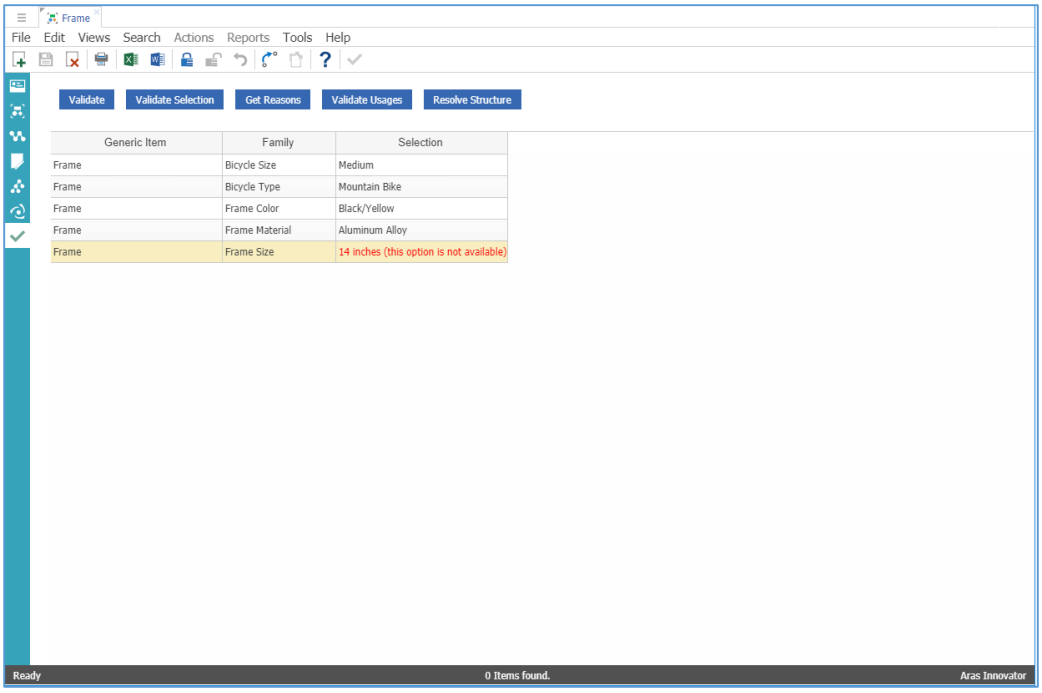


Figure 50.

4. After making the selections, click on **Validate Selections** button.

   If the selected set of options are valid, the following Validate Result dialog is displayed.

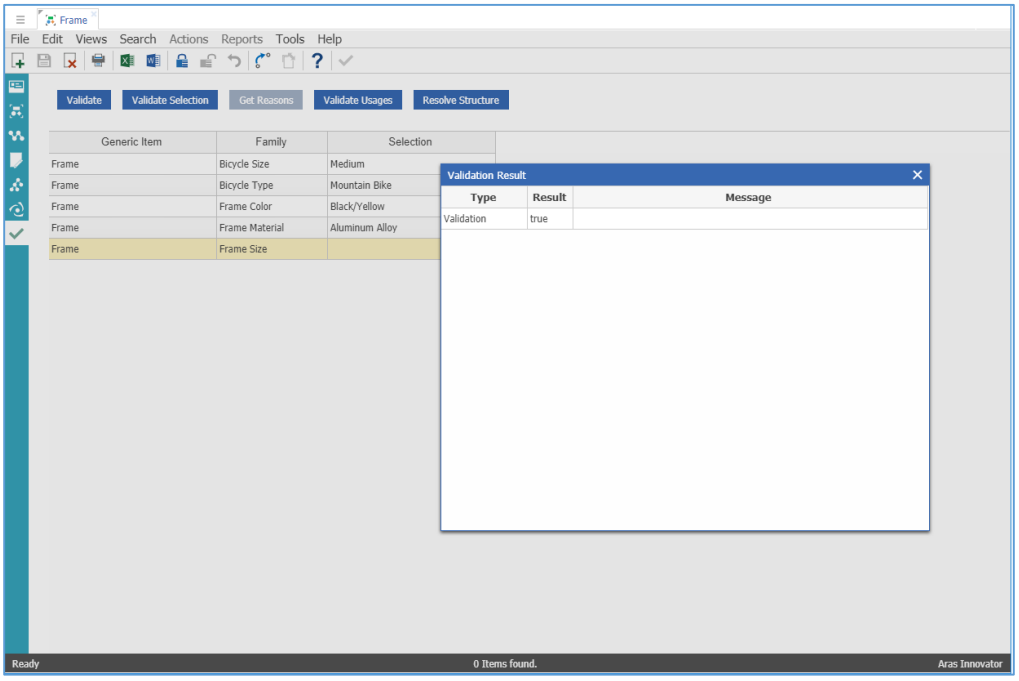


Figure 51.

If the selected set of options are invalid, Validate Results dialog shows that a message like below:

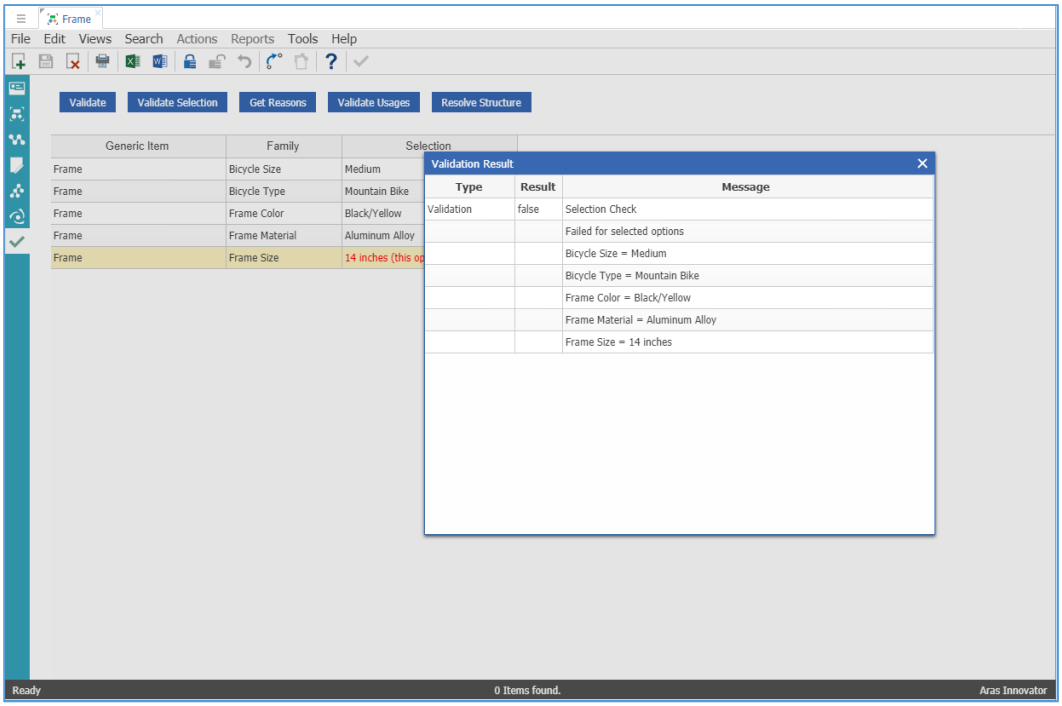


Figure 52.

4.14.3 Getting Reasons for Invalid Option Selections

This action opens a UI dialog with graphic representation of reasons that cause the Scope be invalid for option selections made in the grid.

Use the following procedure to get reasons for invalid option selections.

1. Open a Generic Item, and click the **Validation and Resolution** icon in the sidebar.
2. Make invalid selections. This can be a complete or partial set of selections. A complete selection is when an option is selected on every row. A partial selection is when option selection is left blank on one or more rows.

   When an invalid selection is made, Get Reasons button gets activated.

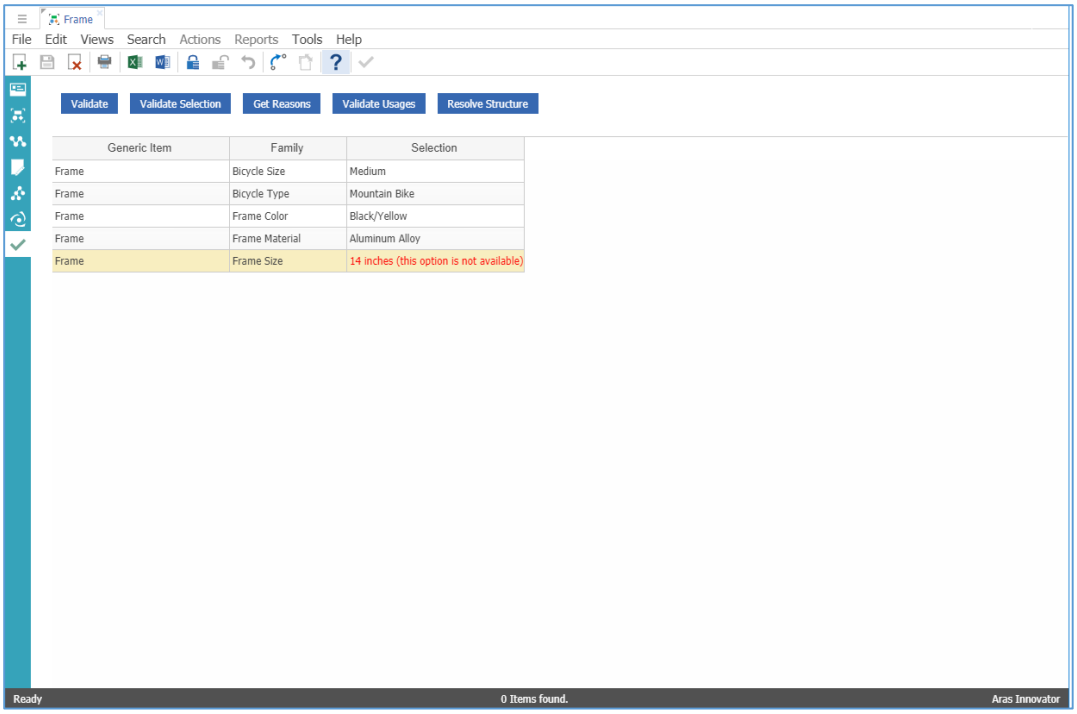


Figure 53.

3. Click **Get Reasons** button. The Conflicts tab appears and displays a diagram that shows where the conflicts occur. The diagram displays several columns. Each column represents a Condition (Scope, Rule, Variable restriction or selected Condition). You see a row for each equivalence used in all of the Conditions that appear in the diagram. Equivalences that are grayed out are not used in the current Condition column. Each Equivalence has a sign associated with it. The plus sign indicates that the equivalence is true. The minus sign indicates that the equivalence is false. The diagram only shows the signs that are valid in Scope for the Condition column. For example, if you have a Rule that says Rule [Color]=[Red], the equivalence [Color]=[Red] will always be for that Rule. The same equivalences should use the same sign in each column in order for the Scope to be valid. Rows containing different signs are highlighted.

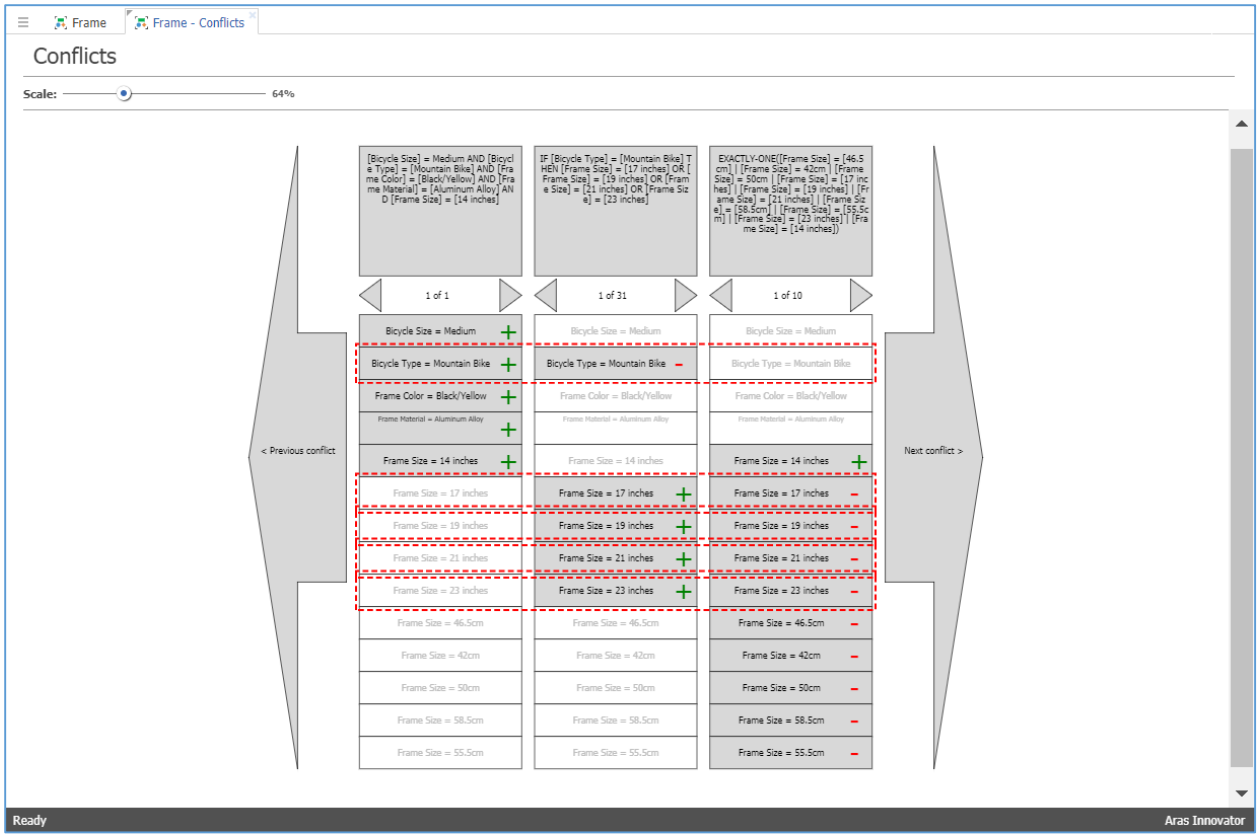


Figure 54.

4.14.4 Validating Part Usages on a Generic Structure

There are two types of Part Usage Validation that need to be performed on Leaf Generic items:

- If each Leaf Generic Item in the Scope can be resolved to at least one Part for any given option combination (Missing)
- If each Leaf Generic Item in the Scope can be resolved to at most (i.e. no more than) one Part for any given option combination (Overlapping)

This validation can be executed for a Generic Item that has a Generic Structure, or a leaf level Generic Item.

Use the following procedure to validate part usages for a Generic Item:

1. Open a Generic Item, and click the **Validation and Resolution** icon in the sidebar.
2. To validate the Generic Item in context, click the **Validate Usages** button without selecting any options in the grid. If there are missing or overlapping parts for generic items in the scope, the list is provided.

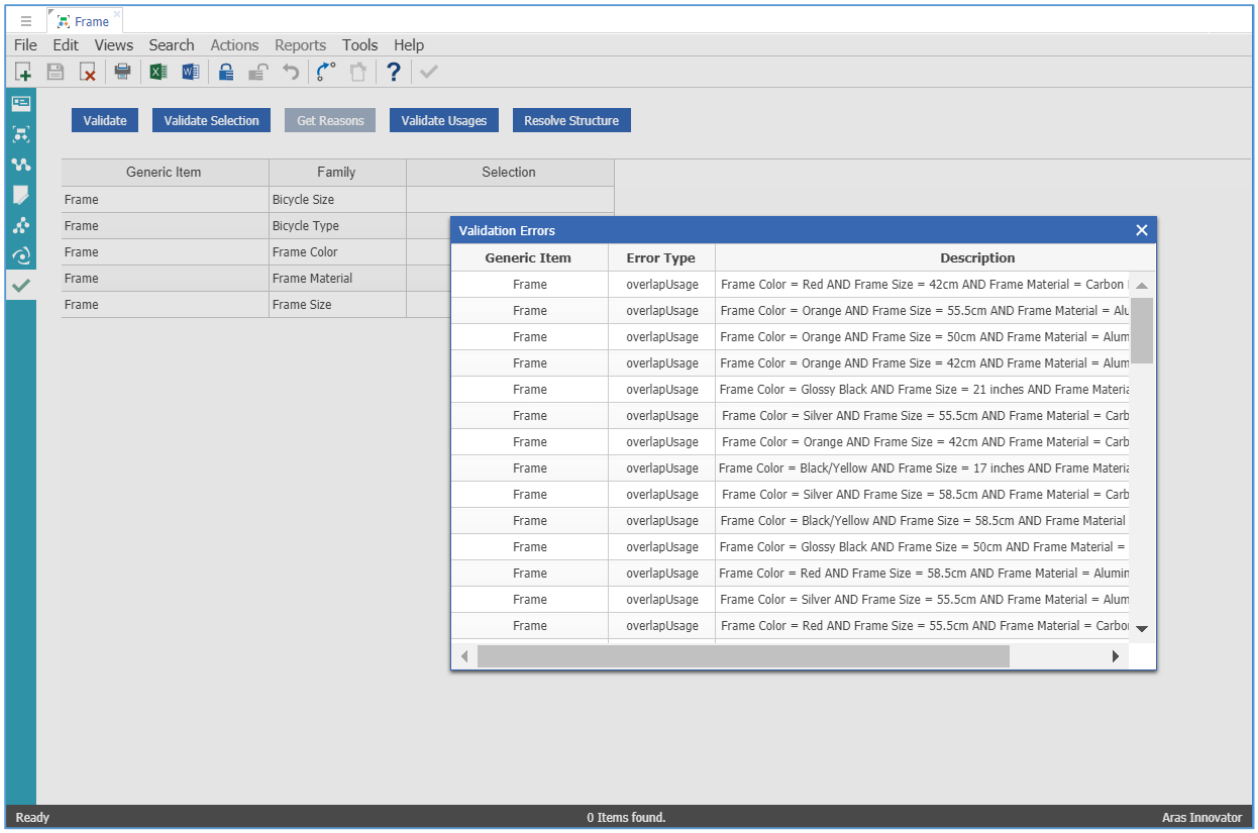


Figure 55.

4.14.4.1 *Missing Parts*

In order to determine if a Generic Item is missing a Part, the code takes usages assigned to the Generic Item, and join expressions from the Usages into one expression using the following format:

```
<not><or>List of Usages</or></not>
```

The code makes a request to the cfg_GetValidCombinations API. If response does not contain a combination, this Generic Item can always be resolved.

4.14.4.2 *Overlapping Parts*

In order to determine if a Generic Item has overlapping usages, the code takes the usages assigned to the Generic Item, and uses the cfg_GetIntersectingExpressions API to resolve this task. The code combines usage expressions to cartesian-square. If the response contains at least one cortege, the Generic Item has overlapping Usages.

4.14.5 Resolving the Structure for Selected Options

Resolution can be executed for a Generic Item that has a Generic Structure, or a leaf level Generic Item. In this resolution, part numbers resolved based on the selected options are displayed in the structure.

Use the following procedure to resolve the structure for a Generic Item:

1. Open a Generic Item, and click the **Validation and Resolution** icon in the sidebar.

2. Make options selections in the grid. This can be a complete or partial set of selections. A complete selection is when an option is selected on every row. A partial selection is when option selection is left blank on one or more rows.

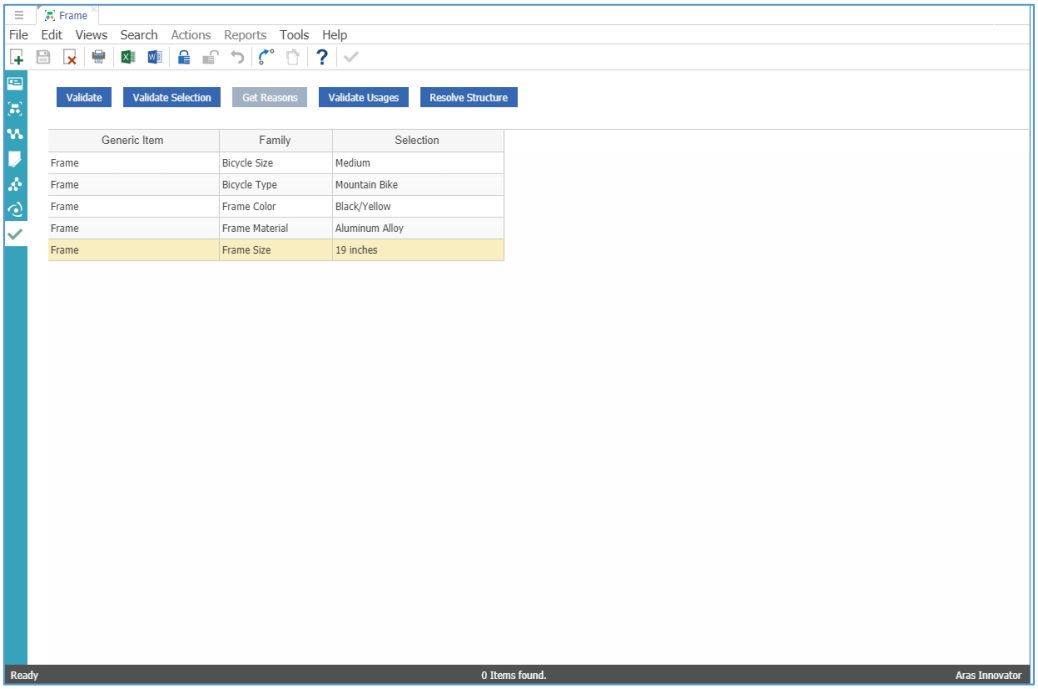


Figure 56.

3. Click **Resolve Structure**. The BOM structure dialog box appears. It displays the structure with Part numbers resolved based on the Options you selected.

   Generic Items are represented as “Assembly({*Generic Item Name*}) where {Generic Item Name} is the name of the Generic Item. Non-Leaf Generic Items are displayed with resolved Parts underneath them.

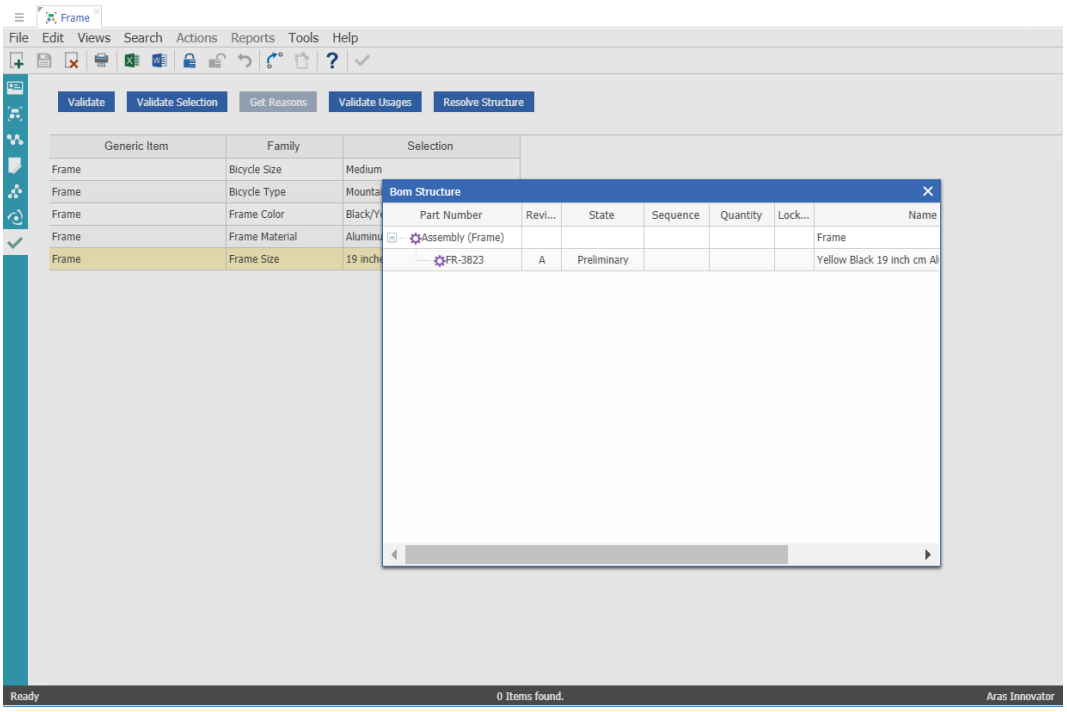


Figure 57.

If you click **Resolve Structure** with partial option selections, the resolved structure displays all of the Parts for the partial selection.

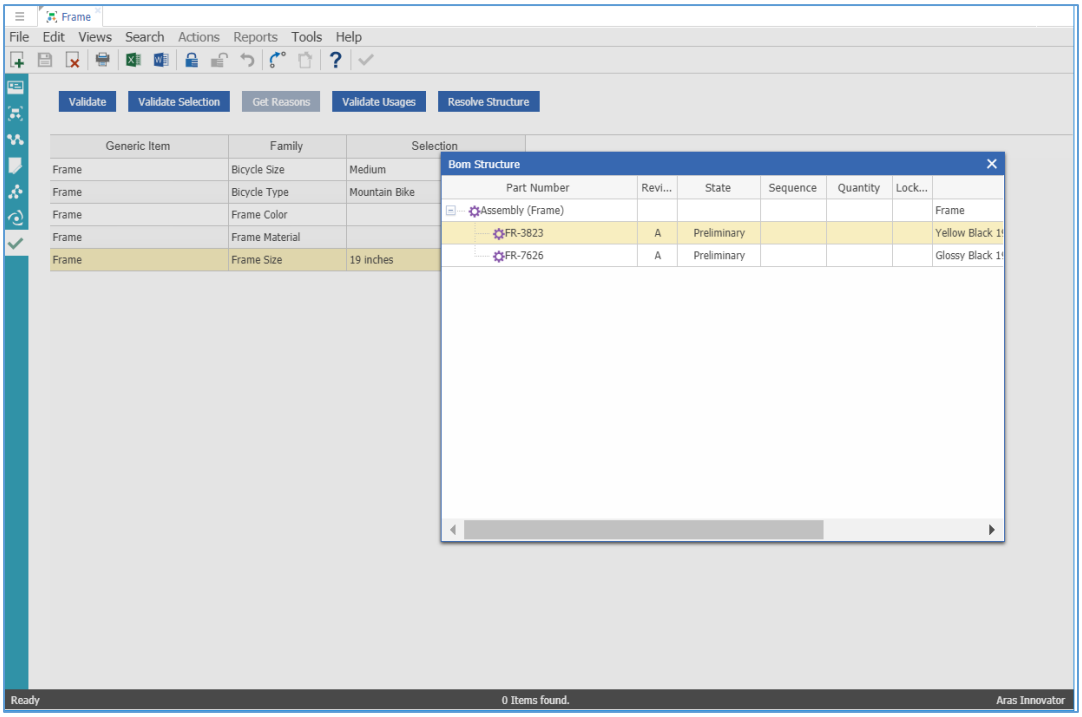


Figure 58.

For a Generic Item with a Generic Structure, resolution is executed on all of the leaf level Generic Items to find the part numbers. Below is a resolved multi-level Bicycle structure for selected options.

Generic Items are represented as “Assembly({*Generic Item Name*}) where {Generic Item Name} is the name of the Generic Item. Non-Leaf Generic Items are displayed with resolved Parts underneath them.

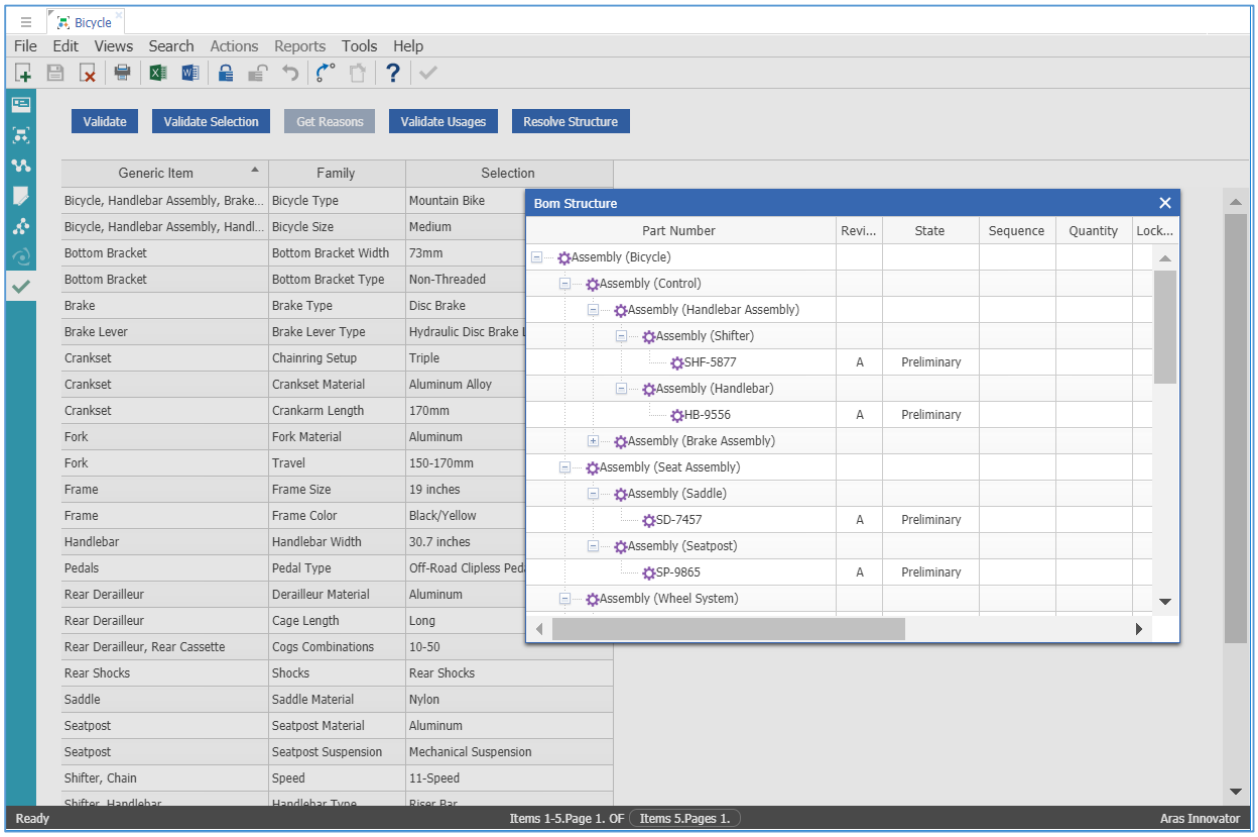


Figure 59.

If there is a fixed part for a generic item (i.e. a part that is common to all variants for the BOM), it is displayed in the resolved structure. In below example, Part FixedPart123 is a common part within Frame Generic Item.

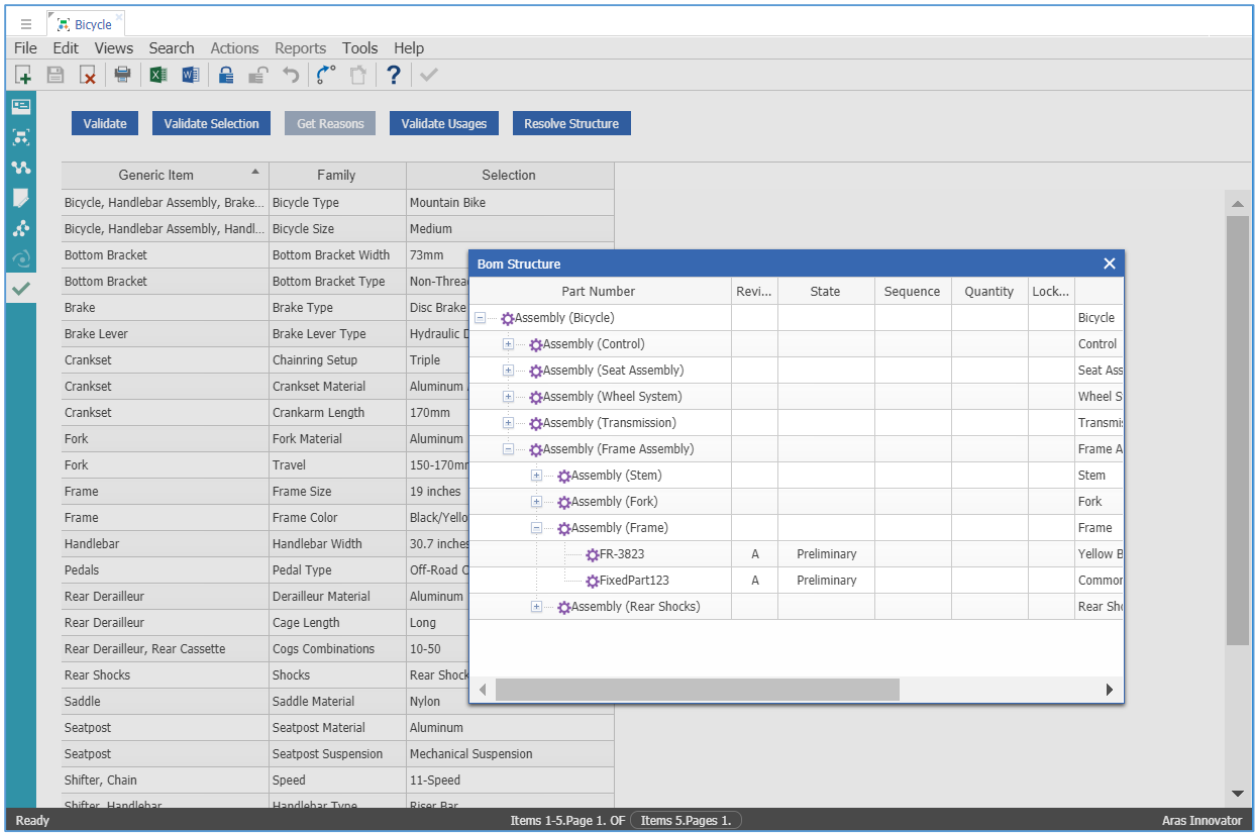


Figure 60.

To resolve the Generic Structure, the code calls the cfg_GetValidCombinations API with condition `<and>{selected Options}{Usage Expressions}</and>`
for each Part Usage on each Leaf Generic Item.

5 Appendix A: Sample Data Outline

This appendix outlines the structure used in the sample data for the application. The outline includes the Generic Items and their Relevant Families. The sample data also includes Options, Rules, Usage, and Technical Solutions not shown in the outline below.

Bicycle

Families: Bicycle Size, Bicycle Type

Control

Brake Assembly

Families: Bicycle Type

Brake

Families: Brake Type

Brake Lever

Families: Brake Lever Type

Handlebar Assembly

Families: Bicycle Size, Bicycle Type

Handlebar

Families: Bicycle Size, Handlebar Type, Handlebar Width

Shifter

Families: Handlebar Type, Speed

Frame Assembly

Fork

Families: Bicycle Type, Fork Material, Travel

Frame

Families: Bicycle Size, Bicycle Type, Frame Color, Frame Material, Frame Size

Rear Shocks

Families: Bicycle Type, Shocks

Stem

Families: Bicycle Size, Bicycle Type, Frame Material, Stem Length, Stem Material

Seat Assembly

Saddle

Families: Saddle Material

Seatpost

Families: Seatpost Material, Seatpost Suspension

Transmission

Bottom Bracket

Families: Bicycle Type, Bottom Bracket Type, Bottom Bracket Width

Chain

Families: Bicycle Type, Speed

Crankset

Families: Bicycle Size, Bicycle Type, Chainring Setup, Crankarm Length, Crankset Material

Pedals

Families: Bicycle Type, Pedal Type

Rear Cassette

Families: Bicycle Type, Cogs Combinations

Rear Derailleur

Families: Bicycle Type, Cage Length, Cogs Combinations, Derailleur Material

Wheel System

Families: Bicycle Type

Tire

Families: Tire Size, Tire Width

Wheelset

Families: Rim Size, Rim Width