Enterprise Architect is an intuitive, flexible and powerful UML analysis and design tool for building robust and maintainable software.

This booklet describes the code engineering facilities of Enterprise Architect.
Enterprise Architect - Code Engineering Using UML Models

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Foreword

This user guide describes the code engineering facilities of Enterprise Architect.
1 Code Engineering

Code Engineering is a process that includes automated code generation, reverse engineering of source code and synchronization between the source code and model.

Enterprise Architect also enables you to rapidly model, generate - or forward engineer - and reverse engineer:

- XML Technologies, namely XML Schema (XSD) and Web Service Definition Language (WSDL)
- Database schema, keys, triggers, constraints, RI and other relational database features, for and from a range of database products.

Code Engineering is available in the Professional, Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect.

Code Generation

Enterprise Architect enables you to generate source code from UML model elements, creating a source code equivalent of the Class or Interface element for future elaboration and compilation. In particular you can generate C, C++, C#, Delphi, Java, PHP, Python, ActionScript, Visual Basic and VB.NET source code. The source code generated includes Class definitions, variables and function stubs for each attribute and method in the UML Class. You can use the Source Code Viewer to view any source code you are opening (see the Dockable Windows section of Using Enterprise Architect - UML Modeling Tool).

Note:

You view source code for an element by selecting it and pressing either [Ctrl]+[E] or [F12]. If the element does not have a generation file (that is, code has not been or cannot be generated, such as for a Use Case), Enterprise Architect checks whether the element has a link to either an operation or an attribute of another element. If such a link exists, and that other element has source code, the code for that element displays (see the Connect To Element Feature topic in UML Modeling With Enterprise Architect - UML Modeling Tool).

You can also generate code from three UML behavioral modeling paradigms:

- State Machine diagrams
- Interaction diagrams
- Activity diagrams.

The Code Template Framework (CTF) enables you to customize the way Enterprise Architect generates source code. It also enables you to generate languages that Enterprise Architect does not specifically support, by helping you define the appropriate code generation templates for that language (this is discussed in SDK for Enterprise Architect).

You can link the facilities of Enterprise Architect to other development environments. The MDG Link for Eclipse and MDG Link for Visual Studio .NET are standalone products that provide an enhanced code engineering functionality between Enterprise Architect and the development environments.

Reverse Engineering

Reverse Engineering is the import of existing source code into model elements, mapping the source code structures onto their UML representations. This enables you to examine legacy code and the functionality of code libraries for reuse, or to bring the UML model up to date with the code. You can reverse engineer in the same languages as you perform code generation with Enterprise Architect.

Enterprise Architect is also able to reverse engineer binary files, namely Java .jar files and .NET PE files.
Note:
Reverse Engineering of other languages including CORBA IDL is also currently available through the use of the MDG Technologies. See [www.sparxsystems.com/resources/mdg_tech/](http://www.sparxsystems.com/resources/mdg_tech/).

Synchronization

*Synchronization* is when changes in the model are exported to the source code and changes to source code are imported into the model. This enables you to keep your model and source up to date as the project develops.

Round-Trip Engineering

*Round trip engineering* is a combination of reverse and forward generation of code and includes synchronization between the source code and the model in all but the most trivial of code engineering projects. In order to get the most out of round trip engineering in Enterprise Architect, you should be familiar with the [modeling conventions](http://www.sparxsystems.com) used when generating and reverse engineering the languages you use.
1.1 Reverse Engineering

Reverse Engineering in Enterprise Architect enables you to import existing source code from a variety of code languages into a UML model. Existing source code structures are mapped into their UML representations, for example a Java Class is mapped into a UML Class element with the variables being defined as attributes, methods are modeled as operations and the interactions between the Java Classes being displayed in the UML model Class diagram with the appropriate connectors.

Reverse Engineering enables users to examine legacy code and examine the functionality of code libraries for reuse or to bring the UML model up to date with the code that has been developed as part of a process called synchronization. Examining the code in a UML model enables user to identify the critical modules contained the code, enabling a starting point for understanding of the business and system requirements of the pre-existing system and to enable the developers to gain a better overall understanding of the source code.

To begin the process of importing existing code into Enterprise Architect, an existing source of code must be imported into Enterprise Architect which can be a single directory or a directory structure. Several options are available when performing the reverse engineering process. The Source Code Engineering Options topic contains several options that affect the reverse engineering process. These include:

- If comments are reverse engineered into notes fields, and how they are formatted if they are
- How property methods are recognized
- If dependencies should be created for operation return and parameter types.

It is important to note that when a legacy system is not well designed, simply importing the source into Enterprise Architect does not create an easily understandable UML model. When working with a legacy system that is poorly designed it is useful to break down the code into manageable components by examining the code elements individually. This can be achieved by importing a specific Class of interest into a diagram and then inserting the related elements (see UML Modeling with Enterprise Architect – UML Modeling Tool) at one level to determine immediate relationship to other Classes. From this point it is possible to create Use Cases that identify the interaction between the legacy Classes, enabling an overview of the legacy system's operation.

Copyright ownership is an important issue to take into account when undertaking the process of reverse engineering. In some cases, software might have specific limitations that prohibit the process of reverse engineering. It is important that a user address the issue of copyright before beginning the process of reverse engineering code. Situations that typically lend themselves to reverse engineering source code include source code that:

- You have already developed
- Is part of a third-party library that you have obtained permission to use
- Is part of a framework that your organization uses
- Is being developed on a daily basis by your developers.

Enterprise Architect currently supports reverse engineering in the following programming languages:

- ActionScript
- Ada 2005 (Systems Engineering and Ultimate editions)
- C
- C#
- C++
- Delphi
- Java
- PHP
- Python
- SystemC (Systems Engineering and Ultimate editions)
- Verilog (Systems Engineering and Ultimate editions)
Reverse Engineering

- VHDL (Systems Engineering and Ultimate editions)
- Visual Basic
- Visual Basic .NET

Enterprise Architect is also able to reverse engineer certain types of binary files: Java .jar files and .NET PE files. See Import Binary Module for more information.

Notes:

- Reverse Engineering of other languages is currently available through the use of MDG Technologies from www.sparxsystems.com/resources/mdg_tech/.
- In the Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect, if security is enabled you must have Reverse Engineer From DDL And Source Code permission to reverse engineer source code and synchronize model elements against code. See User Security in UML Models.

1.1.1 Import Source Code

To import source code (reverse engineer) follow the steps below:

1. In the Project Browser, select (or add) a diagram into which to import the Classes.
2. Right-click on the diagram background to open the context menu and either:
   - Select the language to import from the Import from source file(s) submenu, or
   - Click on the Import Language drop-down arrow in the Code Generation toolbar and select the Import | Import xxx files menu option, where xxx represents the language to import.
3. From the file browser that appears, select one or more source code files to import.
4. Click on the Open button to start the import process.

As the import proceeds, Enterprise Architect provides progress information. When all files are imported, Enterprise Architect makes a second pass to resolve associations and inheritance relationships between the imported Classes.
1.1.2 Notes on Source Code Import

Enterprise Architect enables you to import code into your project, in the following programming languages:

- **ActionScript**
- **C**
- **C#**
- **C++**
- **Delphi**
- **Java**
- **PHP**
- **Python**
- **Visual Basic**
- **Visual Basic .NET**

Enterprise Architect supports most constructs and keywords for each coding language. If there is a particular feature you require support for that you feel is missing, please contact Sparx Systems.

You must select the appropriate type of source file for the language, as the source code to import.

**ActionScript**

Appropriate type of source file: `.as`.

**C**

Appropriate type of source file: `.h` header files and/or `.c` files.

When you select a header file Enterprise Architect automatically searches for the corresponding `.c` implementation file to import based on the options for extension and search path specified in the `C options`.

Enterprise Architect does not expand macros that have been used, these must be added into the internal list of `Language Macros`.

**C++**

Appropriate type of source file: `.h` header file.
Enterprise Architect automatically searches for the .cpp implementation file based on the extension and search path set in the C++ options. When it finds the implementation file it can use it to resolve parameter names and method notes as necessary.

When importing C++ source code, Enterprise Architect ignores function pointer declarations. To import them into your model you could create a typedef to define a function pointer type, then declare function pointers using that type. Function pointers declared in this way are imported as attributes of the function pointer type.

Enterprise Architect does not expand macros that have been used; these must be added into the internal list of Language Macros.

**C#**
Appropriate type of source file: .cs.

**Delphi**
Appropriate type of source file: .pas.

**Java**
Appropriate type of source file: .java.

Enterprise Architect supports the AspectJ language extensions.

Aspects are modeled using Classes with the stereotype aspect. These aspects can then contain attributes and methods as for a normal Class. If an intertype attribute or operation is required, you can add a tag className with the value being the name of the Class it belongs to.

Pointcuts are defined as operations with the stereotype of pointcut. These can occur in any Java Class, Interface or aspect. The details of the pointcut are included in the behavior field of the method.

Advice is defined as an operation with the stereotype advice. The pointcut this advice operates on is in the behavior field and acts as part of the method's unique signature. After advice can also have one of the Tagged Values returning or throwing.

**PHP**
Appropriate type of source file: .php, .php4, or .inc.

**Python**
Appropriate type of source file: .py.

**Visual Basic**
Appropriate type of source file: .cls Class file.

**Visual Basic .NET**
Appropriate type of source file: .vb Class file.
1.1.3 Import a Directory Structure

You can import from all source files in a complete directory structure. This process enables you to import or synchronize multiple files in a directory tree in one pass. Enterprise Architect creates the necessary packages and diagrams during the import process.

To import a directory structure, follow the steps below:

1. In the Project Browser, right-click on the target package for the import.
2. From the context menu, select the Code Engineering | Import Source Directory menu option. The Import Source Directory dialog displays.

3. Select the options you require. You can configure:
   - The source directory
   - The source type
   - The file extensions to look at
   - Whether to recurse subdirectories
   - Whether to create a diagram for each package
   - Whether to import additional files as described in the Import Component Types dialog
   - Whether to exclude private members from libraries being imported from the model
   - Whether to create a package for every directory, namespace or file; this might be restricted depending on the source type selected
   - Whether to Synchronize or Overwrite existing Classes when found (if a model Class is found matching the one in code, Synchronize updates the model Class to include the details from the one in code, which preserves information not represented in code such as the location of Classes in diagrams; Overwrite deletes the model Class and generates a new one from code, which deletes and does not replace the additional information)
   - How to handle Classes not found during the import (Prompt for action enables you to review Classes individually)
   - What is shown on diagrams created by the import.

4. Click on the OK button to start.
1.1.4 Import Binary Module

Enterprise Architect enables you to reverse-engineer certain types of binary modules. To import a binary module, right-click on the target package in the Project Browser and select the Code Engineering | Import Binary Module context menu option.

Currently the permitted types are as follows:

- Java Archive (.jar)
- .Net PE file (.exe, .dll); native Windows DLL and EXE files are not supported, only PE files containing .NET assembly data
- Intermediate Language file (.il).

Enterprise Architect creates the necessary packages and diagrams during the import process. Selecting the Do not import private members checkbox excludes private members from libraries from being imported into the model.

When importing .Net files you can import via reflection or via disassembly, or let Enterprise Architect decide the best method - this might result in both types being used. The reflection-based importer relies on a .Net program, and requires the .Net runtime environment to be installed. The disassembler-based importer relies on a native Windows program called Ildasm.exe, which is a tool provided with the MS .Net SDK. The SDK can be downloaded from the Microsoft website.

A choice of import methods is available because some files are not compatible with reflection (such as mscorlib.dll) and can only be opened using the disassembler. However, the reflection-based importer is generally much faster.

You can also configure:

- Whether to Synchronize or Overwrite existing Classes when found (if a model Class is found matching the one in the file, Synchronize updates the model Class to include the details from the one in the file, which preserves information not represented in the file such as the location of Classes in diagrams; Overwrite deletes the model Class and generates a new one from the file, which deletes and does not replace the additional information)
- Whether to create a diagram for each package
- What is shown on diagrams created by the import.
1.1.5 MDG Link and Code Engineering

MDG Link for Eclipse and MDG Link for Visual Studio.NET are standalone products that provide an enhanced code engineering functionality between Enterprise Architect and the development environments.

The MDG Link programs provide a lightweight bridge between Enterprise Architect and the development environment, offering enhanced code generation, reverse engineering and synchronization between code and the UML model. Merging changes can be achieved with minimal effort, and navigation between model and source code is significantly enhanced.


1.1.6 Classes Not Found During Import

When reverse synchronizing from your code, there are times when some Classes might be deliberately removed from your source code. Enterprise Architect's import source directory functionality keeps track of the Classes it expects to synchronize with and, on the Import Directory Structure dialog, provides options for how to handle the Classes that weren't found. You can select the appropriate action so that, at the end of the import, Enterprise Architect either ignores the missing Classes, automatically deletes them or prompts you to handle them.

If you select the Prompt For Action radio button on the Import Directory Structure dialog, to manually review missing Classes, the following dialog displays:

By default, all Classes are marked for deletion. To keep one or more Classes, select them and click on the Ignore button.

1.1.7 Synchronize Model and Code

In addition to generating and importing code, Enterprise Architect provides the option to synchronize the model and source code, creating a model that represents the latest changes in the source code and vice versa. You can use either the model as the source, or the code as the source.

For example: you generated some source code, but made subsequent changes to the model. When you generate code again, Enterprise Architect adds any new attributes or methods to the existing source code, leaving intact what already exists. This means developers can work on the source code and then generate additional methods as required from the model, without having their code overwritten or destroyed.
Reverse Engineering | Synchronize Model and Code

**Note:**

Code synchronization does not change method bodies. Behavioral code generation only works when generating the entire file.

Similarly, you might have made changes to a source code file, but the model has detailed notes and characteristics you do not want to lose. By synchronizing from the source code into the model, you import additional attributes and methods but do not change other model elements.

Using the two synchronization methods above, it is simple to keep source code and model elements up to date and synchronized.

**Note:**

In the Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect, if security is enabled you must have Generate Source Code and DDL permission to synchronize source code with model elements. See User Security in UML Models.

### Synchronize Classes on Forward Generation

When there are features present in the code but not in the model you can use the following buttons during forward synchronization:

**Note:**

These buttons are only available when the **On forward synch, prompt to delete code features not in model** checkbox is selected in the Options - Attributes and Operations dialog.

- **Delete**: when you click on this button the selected code features are removed from the code.
- **Reassign**: when you click on this button the code elements are reassigned to elements in the model (this is only possible when an appropriate model element is present that is not already defined in the code).
- **Ignore**: when you click on this button the code elements not present in the model are ignored completely.
- **Reset to Default**: when you click on this button the settings for synchronizing during forward generation are set to Ignore, meaning that the elements present in the code but not in the model are ignored completely.

![Code features not in model](image)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Action</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ClassLibX()</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>~ClassLibX()</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>StatesProc(StateType.CommandType)</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>TransitionsProc(TransitionType)</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>InitializeStateMachine()</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>runStateMachine()</td>
<td>&lt;none&gt;</td>
<td>operation</td>
</tr>
<tr>
<td>transcend</td>
<td>&lt;none&gt;</td>
<td>attribute</td>
</tr>
<tr>
<td>curTransition</td>
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<td>attribute</td>
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<tr>
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<td>attribute</td>
</tr>
<tr>
<td>curState</td>
<td>&lt;none&gt;</td>
<td>attribute</td>
</tr>
</tbody>
</table>
1.2 Generate Source Code

Generating source code (forward engineering) takes the UML Class or Interface model elements and creates a source code equivalent for future elaboration and compilation. By forward engineering code from the model, the mundane work involved with having to key in Classes and attributes and methods is avoided, and symmetry between model and code is ensured.

Code is generated from Class or Interface model elements, so you must create the required Class and Interface elements to generate from. Add attributes (which become variables) and operations (which become methods).

Before you generate code, you should ensure the default settings for code generation match your requirements. The default generation settings are located in the Source Code Engineering page of the Options dialog (select the Tools | Options | Source Code Engineering menu option). Set up the defaults to match your required language and preferences. Preferences that you can define include default constructors and destructors, methods for interfaces and the Unicode options for created languages. Languages such as Java support namespacing and can be configured to specify a namespace root. In addition to the default settings for generating code, Enterprise Architect supports the following code languages with their own specific code generation options:

- **ActionScript**
- **C**
- **C#** (for both .NET 1.1 and .NET 2.0)
- **C++** (standard, plus .NET managed C++ extensions)
- **Delphi**
- **Java** (including Java 1.5, Aspects and Generics)
- **PHP**
- **Python**
- **Visual Basic**
- **Visual Basic .NET**

The Code Template Framework (CTF) enables you to customize the way Enterprise Architect generates source code and also enables generation of languages that are not specifically supported by Enterprise Architect.

Before generating code, you should also familiarize yourself with the way Enterprise Architect handles local path names. Local path names enable you to substitute tags for directory names (for example %SRC% = C:\Source).

When you have completed the design of your Classes, you can generate source code.

**Note:**

In the Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect, if security is enabled you must have Generate Source Code and DDL permission to generate source code. See User Security in UML Models.

Use Live Code Generation

On the Package Build Scripts dialog, you have the option to update your source code instantly as you make changes to your model. (See the Setup for Build and Run topic in Visual Execution Analyzer in Enterprise Architect.)

**Tasks**

When you generate code, you perform one or more of the following tasks:
1.2.1 Generate a Single Class

To generate code for a single Class, first ensure the design of the model element (Class or Interface) is complete. Also ensure you have added Inheritance connectors to parents and associations to other Classes that are used. Also add Inheritance connectors to Interfaces that your Class implements; Enterprise Architect offers the option to generate function stubs for all interface methods that a Class implements. Once the design is satisfactory, follow the steps below.

**Generate Code for a Single Class**

1. Open the diagram containing the Class or Interface for which to generate code.
2. Right-click on the required Class or Interface to display the context menu and select the **Generate Code** menu option, or press [F11]. The Generate Code dialog displays, which enables you to control how and where your source code is generated.

3. On the **Path** field, click on ... (Browse) and select a path name for your source code to be generated to.
4. In the **Target Language** field, click on the drop-down arrow and select the language to generate; this becomes the permanent option for that Class, so change it back if you are only doing one pass in another language.
5. Click on the **Advanced** button. The **Object Options** dialog displays.
6. Set any custom options (for this Class alone), then click on the Close button to return to the Generate Code dialog.

7. In the Import(s) / Header(s) fields, type any import statements, #includes or other header information. (Note that in the case of Visual Basic this information is ignored; in the case of Java the two import text boxes are merged; and in the case of C++ the first import text area is placed in the header file and the second in the body (.cpp) file.)

8. Click on the Generate button to create the source code.

9. When complete, click on the View button to see what has been generated. Note that you should set up your default viewer/editor for each language type first (see the Source Code Viewer topic in Using Enterprise Architect - UML Modeling Tool). You can also set up the default editor on the DDL page of the Options dialog (Tools | Options | Source Code Engineering | Code Editors).

1.2.2 Generate a Group of Classes

In addition to being able to generate code for an individual Class, you can also select a group of Classes for batch code generation. When you do this, you accept all the default code generation options for each Class in the set.

To Generate Multiple Classes

1. Select a group of Classes and/or interfaces in a diagram.
2. Right-click on an element in the group to display the context menu.
3. Select the Code Generation | Generate Selected elements menu option. The Save As dialog displays, on which you specify the file path and name for each code file. Enter this information and click on the Save button.
4. The Batch Generation dialog displays, showing the status of the process as it executes (the process might be too fast to see this dialog).

Note:

If any of the elements selected are not Classes or interfaces the option to generate code is not available.
1.2.3 Generate a Package

In addition to generating source code from single Classes and groups of Classes, you can also generate code from a package. This feature provides options to recursively generate child packages and automatically generate directory structures based on the package hierarchy. This enables you to generate a whole branch of your project model in one step.

Generate a Package

To generate a package, follow the steps below:

1. In the Project Browser, right-click on the package to generate code for. The context menu displays.

3. In the Synchronize field, click on the drop-down arrow and select the appropriate synchronize option:
   - Synchronize model and code: Classes with existing files are forward synchronized with that file; Classes with no existing file are generated to the displayed target file
   - Overwrite code: All selected target files are overwritten (forward generated)
   - Do not generate: Only selected Classes that do not have an existing file are generated; all other Classes are ignored.
4. Highlight the Classes to generate. Leave unselected any to not generate.
5. To make Enterprise Architect automatically generate directories and filenames based on the package hierarchy, select the Auto Generate Files checkbox. This then enables the Root Directory field, in which you select a root directory under which the source directories are to be generated. By default, the Auto Generate Files feature ignores any file paths that are already associated with a Class. You can change this behavior by also selecting the Retain Existing File Paths checkbox.
6. To include all sub-packages in the output, select the Include Child Packages checkbox.
7. Click on the Generate button to start generating code.

As code generation proceeds Enterprise Architect displays progress messages. If a Class requires an output filename Enterprise Architect prompts you to enter one at the appropriate time (assuming Auto Generate Files is not selected). For example, if the selected Classes include partial Classes, a prompt displays to enter the filename for the second partial Class.

For additional information on the options on the Generate Package Source Code dialog, see the following table:
### 1.2.4 Update Package Contents

Enterprise Architect enables you to synchronize a directory tree. Follow the steps below:

1. In the **Project Browser**, right-click on the root package of the tree to synchronize. The context menu displays.

2. Select the **Code Engineering | Synchronize Package With Code** menu option. The **Synchronize Package Contents** dialog displays.

   ![Synchronize Package Contents Dialog](image)

   **Update Type** panel:
   - Forward engineer (model -> source)
   - Reverse engineer (source -> model)
   - Include child packages

3. In the **Update Type** panel, select the radio button to **Forward Engineer** or **Reverse Engineer** the package Classes.

4. To include child packages in the synchronization, select the **Include child packages in generation** checkbox.
5. Click on the OK button to start.
Enterprise Architect uses the directory names specified when the project source was first imported/generated and updates either the model or the source code depending on the option chosen.

1.2.5 Namespaces

Languages such as Java support package structures or namespaces. Enterprise Architect lets you specify a package as a namespace root, which denotes where the namespace structure starts; all subordinate packages below this point are generated as namespaces to code.

To define a package as a namespace root, right-click on the package in the Project Browser and select the Code Engineering | Set as Namespace Root context menu option. The package icon in the Project Browser changes to include a colored corner ( ).

When you have set the namespace root, the menu option changes to Clear Namespace Root; click on this option to take the namespace root status off the package. (Also, see the context menu described below.)

Once you have set a namespace root, Java code generated beneath this root automatically adds a package declaration at the head of the generated file indicating the current package location.

To view a list of namespaces, select the Settings | Namespaces menu option. The Namespaces dialog displays.

If you double-click on a namespace in the list, the package is highlighted in the Project Browser. Alternatively, right-click on the namespace to display a context menu, and select the Locate Package in Browser menu option.
You can also clear the selected namespace, by selecting the **Clear Namespace Attribute** option.
1.3 Code Generation From Behavioral Model

Notes:
- Software code generation from behavioral models is available in the Business and Software Engineering, Systems Engineering and Ultimate editions of Enterprise Architect.
- Hardware code generation from State Machine models is available in the Systems Engineering and Ultimate editions of Enterprise Architect.
- For C(OO), please ensure that, on the C Specifications page of the Options dialog, you have set the Object Oriented Support option to True.
- To be able to generate code from behavioral models, all behavioral constructs should be contained within a Class.

Enterprise Architect's system engineering capability facilitates code generation from each of the following UML behavioral diagrams:
- State Machine diagrams (SW & HW)
- Interaction (Sequence) diagrams (SW)
- Activity diagrams (SW).

You can generate code in various software and hardware languages, including C(OO), C++, C#, Java, VB.Net, VHDL, Verilog and SystemC.

To experiment with code generation from these diagrams, use the EAExample project provided with your Enterprise Architect installer.

1.3.1 SW Code Generation - State Machine Diagrams
Note:
To be able to generate code from behavioral models, all behavioral constructs should be contained within a Class.

A State Machine (see The UML Dictionary) in a Class internally generates the following constructs in software languages to enable effective execution of the States' behaviors (do, entry and exit) and also to code the appropriate transition's effect when necessary.

Enumerations
- **StateChanged** - comprises an enumeration for each of the States contained within the State Machine
- **TransitionType** – comprises an enumeration for each transition that has a valid effect associated with it; for example **ProcessOrder_Delivered_to_ProcessOrder_Closed**
- **CommandType** – comprises an enumeration for each of the behavior types that a State can contain (Do, Entry, Exit).

Attributes
- **currState:**StateChanged - a variable to hold the current State's information
- **nextState:**StateChanged – a variable to hold the next State's information, set by each State's transitions accordingly
- **currTransition:**TransitionType – a variable to hold the current transition information; this is set if the transition has a valid effect associated with it
- **transcend:**Boolean - a flag used to advise if a transition is involved in transcending between different State Machines (or Submachine states)
- **xx_history:**StateChanged – a history variable for each State Machine/Submachine State, to hold information about the last State from which the transition took place.

Operations
- **StatesProc** - a States procedure, containing a map between a State's enumeration and its operation; it de-references the current State's information to invoke the respective State's function
- **TransitionsProc** - a Transitions procedure, containing a map between the Transition's enumeration and its effect; it invokes the respective effect
- **<<State>>** - an operation for each of the States contained within the State Machine; this renders a State's behaviors based on the input **CommandType**, and also executes its transitions
- **initializeStateMachine** – a function that initializes all the framework-related attributes
- **runStateMachine** - a function that iterates through each State, and executes their behaviors and transitions accordingly.

Click here to display an example of Java code generated from the State Machine diagram above.

### 1.3.1 Java Code Generated From State Machine Diagram

```java
private enum StateType : int
{
    ProcessOrder_Delivered,
    ProcessOrder_Packed,
    ProcessOrder_Closed,
    ProcessOrder_Dispatched,
    ProcessOrder_New,
    ST_NOSTATE
}
private enum TransitionType : int
{
    ProcessOrder_Delivered_to_ProcessOrder_Closed,
    TT_NOTRANSITION
}
private enum CommandType
{
    Do,
    Entry,
    Exit
}
```
private StateType currState;
private StateType nextState;
private TransitionType currTransition;
private boolean transcend;
private StateType ProcessOrder_history;
private void processOrder_Delivered(CommandType command)
{
    switch(command)
    {
    case Do:
        {
            // Do Behaviors..
            setStatus(Delivered);
            // State's Transitions
            if((status==Delivered))
                {
                    nextState = StateType.ProcessOrder_Closed;
                    currTransition = TransitionType.ProcessOrder_Delivered_to_ProcessOrder_Closed;
                }
        }
    break;
    default:
    {
        break;
    }
    }
}
private void processOrder_Packed(CommandType command)
{
    switch(command)
    {
    case Do:
        {
            // Do Behaviors..
            setStatus(Packed);
            // State's Transitions
            nextState = StateType.ProcessOrder_Dispatched;
            break;
        }
    default:
    {
        break;
    }
    }
}
private void processOrder_Closed(CommandType command)
{
    switch(command)
    {
    case Do:
        {
            // Do Behaviors..
            // State's Transitions
            break;
        }
    default:
    {
        break;
    }
    }
}
private void processOrder_Dispatched(CommandType command)
{
    switch(command)
    {
    case Do:
        {
            // Do Behaviors..
            setStatus(Dispatched);
            // State's Transitions
            nextState = StateType.ProcessOrder_Delivered;
        }
    case Packed:
        {
            // Do Behaviors..
            setStatus(Packed);
            // State's Transitions
            nextState = StateType.ProcessOrder_Packed;
        }
    default:
    {
        break;
    }
    }
}
private void processOrder_New(CommandType command) {
    switch(command)
    {
    case Do:
        {
            // Do Behaviors...
            setStatus(new);
            // State's Transitions
            nextState = StateType.ProcessOrder_Packed;
            break;
        }
    default:
        {
            break;
        }
    }
}

private void StatesProc(StateType currState, CommandType command) {
    switch(currState)
    {
    case ProcessOrder_Delivered:
        {
            processOrder_Delivered(command);
            break;
        }
    case ProcessOrder_Packed:
        {
            processOrder_Packed(command);
            break;
        }
    case ProcessOrder_Closed:
        {
            processOrder_Closed(command);
            break;
        }
    case ProcessOrder_Dispatched:
        {
            processOrder_Dispatched(command);
            break;
        }
    case ProcessOrder_New:
        {
            processOrder_New(command);
            break;
        }
    default:
        {
            break;
        }
    }
}

private void TransitionsProc(TransitionType transition) {
    switch(transition)
    {
    case ProcessOrder_Delivered_to_ProcessOrder_Closed:
        {
            setStatus(closed);
            break;
        }
    default:
        {
            break;
        }
    }
}
private void initializeStateMachine()
{
    currState = StateType.ProcessOrder_New;
    nextState = StateType.ST_NOSTATE;
    currTransition = TransitionType.TT_NOTRANSITION;
}

private void runStateMachine()
{
    while(true)
    {
        if (currState == StateType.ST_NOSTATE)
        {
            break;
        }

        currTransition = TransitionType.TT_NOTRANSITION;
        StatesProc(currState, CommandType.Exit);
        // then check if there is any valid transition assigned after the do behavior
        if (nextState == StateType.ST_NOSTATE)
        {
            break;
        }

        if (currTransition != TransitionType.TT_NOTRANSITION)
        {
            TransitionsProc(currTransition);
        }

        if (currState != nextState)
        {
            StatesProc(currState, CommandType.Exit);
            StatesProc(nextState, CommandType.Entry);
            currState = nextState;
        }
    }
}

1.3.2 State Machine Modeling For HDLs

Note:

To be able to generate code from behavioral models, all behavioral constructs should be contained within a Class.

For efficient code generation from State Machine models into Hardware Description Languages (HDL) such as VHDL, Verilog and Systems C, apply the design practices outlined in this topic.

In an HDL State Machine model, the following are expected:

- Designate Driving Triggers
- Establish Port–Trigger Mapping
- Active State Logic

Designate Driving Triggers

The top level State Machine diagram should be used to model the different modes of a hardware component, and the associated triggers that drive them, as shown in the following diagram.
Asynchronous Triggers

Asynchronous triggers should be modeled according to the following pattern:

1. The trigger should be of type Change (specification: true / false)
2. The active state (Submachine State) should have a transition trigger by it.
3. The target state of the triggered transition should have a self transition with the same trigger

Clock

A trigger of type time, which triggers the transitions to the active state (Submachine State) is deemed as the Clock. The specification of this trigger should be specific to the target language.

Clock Trigger Specifications

<table>
<thead>
<tr>
<th>Trigger Type</th>
<th>Language</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Positive Edge Triggered</td>
</tr>
<tr>
<td>Time</td>
<td>VHDL</td>
<td>rising_edge</td>
</tr>
<tr>
<td></td>
<td>Verilog</td>
<td>posedge</td>
</tr>
<tr>
<td></td>
<td>SystemC</td>
<td>positive</td>
</tr>
</tbody>
</table>
Establish Port – Trigger Mapping

After successfully modeling the different operating modes of the component, and the triggers associated with them, you must associate the triggers with the component's ports as shown in the following diagram.

A Dependency relationship from the Port to the associated trigger should be used to signify their association.

See Also:
- State Diagram } See The UML Dictionary
- Transition }
- SW Code Generation - State Machine Diagrams

Active State Logic

The first two aspects, above, put in place the preliminaries required for efficient interpretation of the hardware components. The actual State Machine logic is now modeled within the Active (Submachine) state.

Note:
The current code generation engine supports only one clock trigger for a component.
1.3.3 Code Generation - Interaction Diagrams

**Note:**
To be able to generate code from behavioral models, all behavioral constructs should be contained within a Class. For an Interaction (Sequence) diagram, the behavioral code generation engine expects the Sequence diagram and all its associated messages and interaction fragments to be encapsulated within an Interaction element (see The UML Dictionary).

During code generation from Interaction (Sequence) diagrams (see The UML Dictionary) in a Class, Enterprise Architect applies its system engineering graph optimizer to transform the Class constructs into programmatic paradigms. Messages and Fragments are identified as one of the several action types based on their functionality, and Enterprise Architect uses the EASL code generation templates to render their behavior accordingly. For example:

- A Message that invokes an operation is identified as an Action Call and is rendered accordingly
- Combined Fragments are identified by their types and conditions; for instance, an Alt fragment is identified as an Action If, and a loop fragment is identified as an Action Loop.

For more information on the EASL code generation macros and templates Enterprise Architect uses to generate code from behavioral models see the EASL Code Generation Macros topic in the Code Template Framework in SDK section of SDK for Enterprise Architect.

The above diagram contains:

- A Combined Fragment (alt), which is identified as an Action If (see The UML Dictionary)
- An Interaction Occurrence, which is identified as an Action Call with all argument information associated with it (see The UML Dictionary), and
- A message (Action Opaque).

The Java code generated from this diagram resembles the following:

```java
public void newTransaction(){
    // behavior is an Interaction
    if (bValidUser) // Alt combined fragment
    {
        placeOrder(101); //Interaction Occurrence
    }
}
```
1.3.4 Code Generation - Activity Diagrams

Note:
To be able to generate code from behavioral models, all behavioral constructs should be contained within a Class.

Code generation from an Activity diagram (see The UML Dictionary) in a Class requires a validation phase, during which Enterprise Architect uses the system engineering graph optimizer to analyze the diagram and render it into various code-generatable constructs. Enterprise Architect also transforms the constructs into one of the various action types (if appropriate), similar to the Interaction diagram constructs. Enterprise Architect then uses the EASL code generation macros to generate code from these constructs.

For more information on the EASL code generation macros and templates Enterprise Architect uses to generate code from behavioral models see the EASL Code Generation Macros topic in the Code Template Framework in SDK section of SDK for Enterprise Architect.

To provide a comprehensive analysis of these features several diagrams from the EAExample project are shown as examples.

Conditional Statements
To model a conditional statement, you use Decision/Merge nodes. Alternatively, you can imply Decisions/Merges internally. The graph optimizer expects an associated Merge node for each Decision node, to facilitate efficient tracking of various branches and analysis of the code constructs within them.

The following diagram is interpreted as a nested IF statement.
The Java code that might be generated from this diagram is as follows:

```java
public boolean doValidateUser(String Password, String UserName)
{
    loadAccountDetails();
    boolean bRet;
    if (Username == name)
    {
        if (Password == password)
        {
            bRet = true;
            bValidUser = true;
        }
        else
        {
            bRet = false;
        }
    }
    else
    {
        bRet = false;
    }
    return bRet;
}
```
Invocation Actions (Call Operation Action, Call Behavior Action)

*Call Actions* are handled more efficiently. Each action has arguments relating to the parameters of the associated behavior (use the Synchronize button of the Arguments dialog to synchronize arguments and parameters).

The following diagram demonstrates the use of a *Call Behavior Action* and a *Call Operation Action* interspersed with a conditional statement.

![Diagram](image)

The generated Java code might appear as follows:

```java
public void doMarkAccountClosed()
{
    doValidateUser(password,name);
    if (bValiduser)
    {
        setClosed(true);
    }
    else
    {
        System.out.println("Invalid user");
    }
    return;
}
```
Loops

Enterprise Architect's system engineering graph optimizer is also capable of analyzing and identifying loops. An identified loop is internally rendered as an Action Loop, which is translated by the EASL code generation macros to generate the required code.

The following diagram demonstrates how a loop can be modeled.

```java
public void doCheckForOutstandingOrders()
{
    if (status != closed)
    {
        initializeStateMachine();
        while (status != closed)
        {
            runStateMachine();
        }
    }
}
```

The generated Java code might appear as follows:
} 
else 
{ 
    //No Outstanding orders;
} 
return; 
}
1.4 Code Engineering Settings

You can set the default code options such as the editors for each of the programming languages available for Enterprise Architect and special options for how source code is generated.

See Also
- General Options
- Local Paths
- Local Path Dialog
- Language Macros
- Setting Collection Classes

1.4.1 Source Code Engineering

The following topics describe general options that apply to all languages when generating code from Enterprise Architect. These options are all available under the Source Code Engineering section of the Options dialog (select the Tools | Options | Source Code Engineering menu option).

- Source Code Options
- Options - Code Editors
- Options - Object Lifetimes
- Options - Attribute/Operations
- Synchronize Model and Code
- Code Page for Source Editing

1.4.1.1 Source Code Options

When you generate code for a particular language, you can set certain options. These include:

- Create a default constructor
- Create a destructor
- Generate copy constructor
- Select default language
- Generate methods for implemented interfaces
- Set the unicode options for code generation.

These options are accessed the Source Code Engineering page of the Options dialog (select the Tools | Options | Source Code Engineering menu option).
Most of the settings are self-explanatory. The **Remove prefixes when generating Get/Set properties** field enables you to specify prefixes used in your variable naming conventions, if those prefixes should be removed in the variables' corresponding get/set functions.

Click on the **Component Types** button to configure what elements you would like to be created for files of any extension found while importing a source code directory.

**Note:**

It is worthwhile to configure these settings, as they serve as the defaults for all Classes in the model. You can override these on a per-Class basis using the custom settings (from the **Code Generation** dialog).

### 1.4.1.1 Import Component Types

The **Import Component Types** dialog enables you to configure what elements you would like to be created for files of any extension found while importing a source code directory.

To access the **Import Component Types** dialog select the **Tools | Options | Source Code Engineering** menu option to display the **Source Code Engineering** page of the **Options** dialog, and click on the **Component Types** button.
For each extension you can specify:

- The element type to be created
- The stereotype to apply to these objects.

**Note:**
You can transport these import component types between models, using the Export Reference Data and Import Reference Data options on the Tools menu. See the Reference Data topic in UML Model Management.

### 1.4.1.2 Options - Code Editors

You access the source code editor options via the DDL page of the Options dialog (select the Tools | Options | Source Code Engineering | Code Editors menu option). They enable you to configure options for Enterprise Architect's internal editor, as well as the default editor for DDL scripts. You can configure external editors for code languages on each language options page.
The options for the inbuilt editor are:

<table>
<thead>
<tr>
<th>Option</th>
<th>Use to</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use inbuilt editor if no external editor set</td>
<td>Specify the editor for code in a language if no external editor is defined for that language.</td>
</tr>
<tr>
<td>Show Line Numbers</td>
<td>Show line numbers in the editor.</td>
</tr>
<tr>
<td>Enable Outlining</td>
<td>Enable collapsible regions for standard languages.</td>
</tr>
<tr>
<td>Show Structure Tree</td>
<td>Show a tree with the results of parsing the open file (requires that the file is parsed successfully).</td>
</tr>
<tr>
<td>Don't parse files larger than</td>
<td>Specify an upper limit on file size for parsing. Used to prevent performance decrease due to parsing very large files.</td>
</tr>
</tbody>
</table>

### 1.4.1.3 Options - Object Lifetimes

This set of options enables you to configure:

- Constructor details when generating code
- Whether to create a copy constructor
- Destructor details.

These options are accessed via the Constructor page of the Options dialog (select the Tools | Options | Source Code Engineering | Object Lifetimes menu option).
1.4.1.4 Options - Attribute/Operations

This set of options enables you to:

- Configure the default name generated from imported attributes
- Generate methods for implemented interfaces
- Delete model attributes not included in the code during reverse synchronization
- Delete model methods not included in the code during reverse synchronization
- Delete code from features contained in the model during forward synchronization
- Delete model associations and aggregations that correspond to attributes not included in the code during reverse synchronization
- Define whether or not the bodies of methods are included and saved in the Enterprise Architect model when reverse engineering
- Create attributes in quick succession, clearing the dialog when you click on Save so that you can enter another attribute name.

These options are accessed via the Attribute Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | Attribute/Operations menu option).
1.4.1.5 **Code Page for Source Editing**

Enterprise Architect enables you to define the Unicode character set for code generation. To set the Unicode character set follow the steps below:

1. Select the **Tools | Options | Source Code Engineering** menu option. The **Source Code Engineering** page of the **Options** dialog displays.
2. In the **Code page for source editing** field, click on the drop-down arrow and select the appropriate Unicode character set.

3. Click on the **Close** button.

### 1.4.2 Local Paths

Sometimes a team of developers could be working on the same Enterprise Architect model. Each developer might store their version of the source code in their local file system, but not always at the same location as their fellow developers.

Local paths take a bit of setting up, but if you want to work collaboratively on source and model concurrently, the effort is well worth while.

For example: developer A stores their .java files in a `C:\Java\Source` directory, while developer B stores theirs in `D:\Source`. Meanwhile, both developers want to generate and reverse engineer into the same Enterprise Architect model located on a shared (or replicated) network drive.

To handle this scenario, Enterprise Architect enables you to define local paths for each Enterprise Architect user, using the *Local Paths* dialog (select the **Settings | Local Paths** menu option).

In our example, Developer A might define a local path of:

```
JAVA_SOURCE = "C:\Java\Source"
```

All Classes generated and stored in the Enterprise Architect project are stored as:

```
%JAVA_SOURCE%\<xxx.java>.
```

Developer B now defines local path as:

```
JAVA_SOURCE = "D:\Source".
```

Now, Enterprise Architect stores all java files in these directories as:

```
%JAVA_SOURCE%\<filename>
```

On each developer's machine, the filename is expanded to the correct local version.
1.4.3 Local Paths Dialog

The Local Paths dialog enables you to set up local paths for a single user on a particular machine. For a description of what Local Paths are used for, see the Local Paths topic. To open the Local Paths dialog, select the Settings | Local Paths option.

The Local Paths dialog enables you to define:

- **Path** - the local directory in the file system (for example, d:\java\source)
- **ID** - the shared ID that is substituted for the Local Path (for example, JAVA_SRC)
- **Type** - the language type (for example, Java).

And also to:

- **Apply Path** - Select a path and click on this button to update any existing paths in the model (with full pathnames) to the shared relative path name (so d:\java\source\main.java might become %JAVA_SRC%\main.java)
- **Expand Path** - The opposite of Apply Path. This enables you to remove a relative path and substitute the full path name.

Using the two options you can update and change existing paths.

**Note:**

You can also set up a hyperlink (see The UML Dictionary) on a diagram to access the Local Paths dialog, to switch, update or expand your current Local Path.

1.4.4 Language Macros

When reverse engineering a language such as C++, you might find preprocessor directives scattered throughout the code. This can make code management easier, but can hamper parsing of the underlying C++ language.

To help remedy this, you can include any number of macro definitions, which are ignored during the parsing phase of the reverse engineering. It is still preferable, if you have the facility, to preprocess the code using the appropriate compiler first; this way, complex macro definitions and defines are expanded out and can be readily parsed. If you don't have this facility, then this option provides a convenient substitute.
Note:

You can transport these language macro (or preprocessor macro) definitions between models, using the Export Reference Data and Import Reference Data options on the Tools menu. The macros are exported as a Macro List. See the Reference Data topic in UML Model Management.

Define a Macro

1. Select the Settings | Preprocessor Macros menu option. The Language Macros dialog displays.

2. Click on the Add New button.
3. Enter details for your macro.
4. Click on the OK button.

Macros Embedded Within Declarations

Macros are sometimes used within the declaration of Classes and operations, as in the following examples:

```cpp
class __declspec Foo{
    int __declspec Bar(int p);
}
```

If `declspec` is defined as a C++ macro, as outlined above, the imported Class and operation contain a Tagged Value called DeclMacro1 with value `declspec`. (Subsequent macros would be defined as DeclMacro2, DeclMacro3, and so on.) During forward engineering, these Tagged Values are used to regenerate the macros in code.

Define Complex Macros

It is sometimes useful to define rules for complex macros that can span multiple lines. Enterprise Architect ignores the entire code section defined by the rule. Such macros can be defined in Enterprise Architect as in the following two examples. Both types can be combined in one definition.

**Block Macros**

```
BEGIN_INTERFACE_PART ^ END_INTERFACE_PART
```

where the `^` symbol represents the body of the macro. This enables skipping from one macro to another.

**Function Macros**

```
RTTI_EMULATION()
```

**Note:**

The spaces surrounding the `^` symbol are required.

**Function Macros**

```
RTTI_EMULATION()
```
where Enterprise Architect skips over the token including everything inside the parentheses.

### 1.4.5 Set Collection Classes

Enterprise Architect enables you to define Collection Classes for generating code from Association connectors where the target role has a multiplicity setting greater than 1. There are two options for doing this:

1. On the Source Code Engineering section of the Options dialog (select the Tools | Options | Source Code Engineering option), on each language page click on the Collection Classes button.

   ![Collection Classes for Association Roles dialog](image)

   On this dialog, you can define:
   - The default Collection Class for 1..* roles
   - The ordered Collection Class to use for 1..* roles
   - The qualified Collection Class to use for 1..* roles.

2. On the Detail tab of the Class Properties dialog (accessible from the right-click context menu of any Class), click on the Collection Classes button.

   ![Collection Classes](image)

   The Collection Classes for Association Roles dialog again displays, but here you define for when only this Class is used:
   - The default Collection Class for 1..* roles
   - The ordered Collection Class to use for 1..* roles
   - The qualified Collection Class to use for 1..* roles.

When Enterprise Architect generates code for a connector that has a multiplicity role >1, the Collection Class is calculated as follows:

1. If the Qualifier is set use the qualified collection:
   - for the Class if set
   - else use the code language qualified collection.
2. If the Order option is set use the ordered collection:
   - for the Class if set
else use the code language ordered collection.

3. Else use the default collection:
   - for the Class if set
   - else use the code language default collection.

**Note:**
You can include the marker #TYPE# in the collection name; Enterprise Architect replaces this with the name of the Class being collected at source generation time (for example, Vector<#TYPE#> would become Vector<foo>).

Additionally, on both the **Source Role** and **Target Role** tabs of the **Association Property** dialog (accessible from the right-click context menu of any Association) there is a **Member Type** field. If you set this, the value you enter overrides all the above options. The example below shows a defined **PersonList**; when code is generated, because this has a **Multiplicity** greater than 1 and the **Member Type** is defined, the variable created is of type **PersonList**.

1.4.6 Language Options

You can set up various options for how Enterprise Architect handles a particular language when generating code. These options are accessible on the **Options** dialog (select the **Tools | Options** menu option).

Under the **Source Code Engineering** option, select the required language. The following topics outline the options available for each language.

- **ActionScript**
- **Ada 2005** (in the System Engineering and Ultimate editions of Enterprise Architect)
- **ANSI C**
- **C#**
- **C++**
1.4.6.1 ActionScript Options

Configure options for ActionScript code generation using the ActionScript Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | ActionScript menu option). The options you can specify include the:

- Default ActionScript version to generate (AS2.0 or AS3.0)
- Default file extensions (header and source)
- Default source directory
- Editor for ActionScript code.

1.4.6.2 Ada 2005 Options

Note:
Ada 2005 support is available in the System Engineering and Ultimate editions of Enterprise Architect.

Configure options for Ada 2005 code generation using the Ada page of the Options dialog (select the Tools |
Options | Source Code Engineering | Ada menu option). The options you can specify include:

- Use Class Name for Tagged Record - to inform the reverse engineering process whether the name of the Tagged Record is the same as the package name
- Alternate Tagged Record Name - to advise the engine of the alternate Tagged Record name to locate
- Define Reference for Tagged Record - to specify whether the engine should create a reference type for the Tagged Record (if one is not defined)
- Reference Type Name - to supply the name of the reference type to be created (default is \textit{Ref})
- Ref Parameter Style - to specify the reference parameter of a Reference / Access type
- Ignore Reference Parameter Name - to tell the engine to ignore the name of the reference parameter
- Ref Parameter Name - to indicate the name of the reference parameter to locate

![Options settings screenshot]

1.4.6.3 C Options

Configure options for C code generation using the C Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | C menu option). The options you can specify include:

- Support for Object Oriented coding
- Default file extensions (header and source)
- Default source directory
- Editor for C code
- Path that Enterprise Architect uses to search for the implementation file; the first path in the list is the default path when generating.
1.4.6.4 C# Options

Configure options for C# code generation using the C# Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | C# menu option). The options you can specify include the default:

- File extension
- 'Get' prefix
- 'Set' prefix
- Directory for opening and saving C# source code.
1.4.6.5 **C++ Options**

Configure options for C++ code generation using the C++ Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | C++ menu option). The options you can specify include:

- The version of C++ to generate; this controls the set of templates used and how properties are created
- The default reference type used when a type is specified by reference
- The default file extensions
- Default Get/Set prefixes
- Default source directory
- The path that Enterprise Architect uses to search for the implementation file. The first path in the list is the default path when generating new implementation files and parsing existing files; if you add further directories, Enterprise Architect also searches these when parsing existing files.

For example, you have a directory `inc` that contains all of your headers, while the source code is mixed through directories `src`, `srca`, and `srcb. You therefore set the Source Path option to `../src;../srca;../srcb/`. This ensures that new implementation files are generated into `src`, but when parsing existing files Enterprise Architect looks in all three source directories (but never in the `inc` directory). You must still ensure that the implementation file name matches the header file name, and that the file extension matches the extension specified in the options. If these conditions are not met, Enterprise Architect cannot handle that code.
1.4.6.6 Delphi Options

Configure options for Delphi code generation using the Delphi Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | Delphi menu option). The options you can specify include the:

- Default file extension
- Default source directory

You can also set a default directory for opening and saving Delphi source code.
You should also set Delphi properties within each Class element.

1.4.6.6.1 Delphi Properties

Enterprise Architect has comprehensive support for Delphi properties. These are implemented as Tagged Values, with a specialized property editor to help create and modify Class properties. The Class image below illustrates the appearance of a Delphi Class that has had properties added to it. These are stored as Tagged Values, and by using the Feature Visibility element context menu option, you can display the ‘tags’ compartment that contains the properties. Imported Delphi Classes with properties have this feature automatically made visible for your convenience.

Note:
When you use the Create Property dialog from the Attribute screen, Enterprise Architect generates a pair of Get and Set functions, together with the required property definition as Tagged Values. You can manually edit these Tagged Values if required.
To manually activate the property editor

1. Ensure the Class you have selected has the code generation language set to Delphi
2. Right-click on the Class and select the Delphi Properties context menu option to open the editor.

The Delphi Properties editor enables you to build properties in a simple and straightforward manner. From here you can:

- Change the name and scope (only Public and Published are currently supported)
- Change the property type (the drop-down list includes all defined Classes in the project)
- Set the Read and Write information (the drop-down lists have all the attributes and operations from the current Class; you can also enter free text)
- Set Stored to True or False
- Set the Implements information
- Set the Default value, if one exists.
Notes:

- Public properties are displayed with a '+' symbol prefix and published with a '^'.
- When creating a property in the Create Property Implementation dialog (accessed through the Attributes dialog), you can set the scope to Published if the property type is Delphi - see the example below.

Limitations

- Only Public and Published are supported
- If you change the name of a property and forward engineer, a new property is added, but the old one must
be manually deleted from the source file.

### 1.4.6.7 Java Options

Configure options for Java code generation using the Java Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | Java menu option). The options you can specify include the:

- Default file extension
- Default 'Get' prefix
- Default 'Set' prefix

You can also set a default directory for opening and saving Java source code.

![Java Specifications](image)

### 1.4.6.8 PHP Options

Configure options for PHP code generation using the PHP Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | PHP menu option). The options you can specify include the:

- Default source extension - specify the extension to be used when creating files for PHP source
- Default import extension - a semi-colon separated list of extensions to look at when doing a directory code import for PHP
- Default PHP version - the version of PHP to generate.

You can also set a default directory for opening and saving PHP source code.
1.4.6.9 Python Options

Configure options for Python code generation using the Python Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | Python menu option). The options you can specify include the:

- Default file extension(s)
- Default source directory.

You can also set the editor for Python code.
1.4.6.10 SystemC Options

Configure options for SystemC code generation using the SystemC page of the Options dialog (select the Tools | Options | Source Code Engineering | SystemC menu option). The options you can specify include the:

- Default file extension(s)
- Default source directory
- Editor for changing code.
1.4.6.11 VB.Net Options

Configure options for VB.Net code generation using the VB.Net Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | VB.Net menu option). The options you can specify include the:

- Default file extension
- Default source directory.
1.4.6.12 Verilog Options

Configure options for Verilog code generation using the Verilog page of the Options dialog (select the Tools | Options | Source Code Engineering | Verilog menu option). The options you can specify include the:

- Default file extension(s)
- Default source directory
- Editor for changing code.
1.4.6.13 VHDL Options

Configure options for VHDL code generation using the VHDL page of the Options dialog (select the Tools | Options | Source Code Engineering | VHDL menu option). The options you can specify include the:

- Default file extension(s)
- Default source directory
- Editor for changing code.
1.4.6.14 Visual Basic Options

Configure options for Visual Basic code generation using the VB Specifications page of the Options dialog (select the Tools | Options | Source Code Engineering | Visual Basic menu option). The options you can specify include the:

- Default file extension when reading/writing
- Default Visual Basic version
- MTS transaction mode for MTS objects
- Multi use (true or false)
- Persistable
- Data binding
- Global namespace
- Exposed
- Data source behavior
- Creatable.
1.4.6.15 MDG Technology Language Options

If you have loaded an MDG Technology that specifies a code module into your Sparx Systems > EA > MDG Technologies folder (see the MDG Technologies in SDK section of SDK For Enterprise Architect), the language is included in the Source Code Engineering list on the Options dialog. The language is only listed on the Options dialog if an MDG Technology file actually uses it in your model.

The options for each language are based on what is defined in the technology code module, but are limited to the following:

- **Default Extension**
  - Default extension for generated source files
  - Shown if the option is in the technology
  - Saved per project.

- **Import File Extensions**
  - Default folder to import source files from
  - Shown if there is a grammar set in the technology
  - Saved once for all projects.

- **Generate Namespaces**
  - Option to generate namespaces or not
  - Shown if the technology supports namespaces
  - Saved once for all projects.

- **Default Source Directory**
  - The default directory to save generated source files
  - Always shown
  - Saved once for all projects.

- **Editor**
  - The editor that is loaded to edit the source files
  - Always shown
  - Saved once for all projects.
• Att Type
  • Default type for attributes
  • Always shown
  • Saved once for all projects.

These options are set in the technology inside the `<CodeOptions>` tag of a code module, as follows:

```xml
<CodeOption name="DefaultExtension">.rb</CodeOption>
```

1.4.6.16 Reset Options

Enterprise Architect stores some of the options for a Class when it is first created. Some are global; for example `$LinkClass` is stored when you first create the Class, so it won't automatically pick up the global change in the Options dialog in existing Classes. You must modify the options for the existing Class.

**Modify Options for Single Class**

To modify options for a single Class, follow the steps below:

1. Right-click on the Class to change, and select the **Generate Code** menu option from the context menu. The **Generate Code** dialog displays.
2. Click on the **Advanced** button. The **Object Options** dialog displays.
3. Click on the **Attributes/Operations** button.
4. Change the options, and click on the **Close** button to apply changes.

**Modify Options for All Classes**

To modify options for all Classes within a package, follow the steps below:

1. Right-click on the package in the **Project Browser**. The context menu displays.
2. Select the **Code Engineering | Reset Options for this Package** menu option. The **Manage Code Generation** dialog displays.
3. Reset the required defaults for each existing Class.
4. Click on the **OK** button to apply changes.
1.5 Code Template Framework

The Code Template Framework (CTF) is used during forward engineering of UML models. The CTF enables you to:

- Generate source code from UML models
- Customize the way in which Enterprise Architect generates source code
- Forward engineer languages not specifically supported by Enterprise Architect.

The CTF consists of:

- Default Code Templates, which are built into Enterprise Architect for forward engineering supported languages
- A Code Template Editor for creating and maintaining user-defined Code Templates (also see SDK for Enterprise Architect)
- Code templates to synchronize code.

1.5.1 Code Templates

Code templates enable you to customize code generation of existing languages. For example:

- Modify the file headers created when generating new files
- Change the style of the generated code (such as indenting or brace position) to match the required coding standards
- Handle particular stereotypes to generate things like specialized method bodies and extra methods.

They also enable you to add code generation of entirely new languages that Enterprise Architect would otherwise not be able to handle. In this situation it is most useful to combine code templates with an MDG technology file that includes the datatypes, and options for default file extensions. See the Create MDG Technologies topic in SDK for Enterprise Architect.

Enterprise Architect's base code templates specify the transformation from UML elements to the various parts of a given programming language. The templates are written as plain text with a syntax that shares some aspects of both mark-up languages and scripting languages. A simple example of a template used by Enterprise Architect is the 'Class template'. It is used to generate source code from a UML Class:

```
%ClassNotes%
%ClassDeclaration%
%ClassBody%
```

The above template simply refers to three other templates, namely ClassNotes, ClassDeclaration and ClassBody. The enclosing percent (%) signs indicate a macro. Code Templates consist of various types of macros, each resulting in a substitution in the generated output. For a language such as C++, the result of processing the above template might be:

```
/** * This is an example class note generated using code templates * @author Sparx Systems */
class ClassA: public ClassB{
  ...
}
```

Execution of Code Templates

A reference to a template (such as the %ClassNotes% macro, from our example above) results in the execution of that template.

Each template is designed for use with a particular element. For example the ClassNotes template is to be
used with UML Class elements.

The element that is currently being generated is said to be in scope. If the element in scope is stereotyped Enterprise Architect looks for a template that has been defined for that stereotype. If a match is found, the specialized template is executed. Otherwise the default implementation of the base template is used.

Templates are processed sequentially, line by line, replacing each macro with its underlying text value from the model.

### 1.5.1.1 Base Templates

The Code Template Framework consists of a number of base templates. Each base template transforms particular aspects of the UML to corresponding parts of object-oriented languages.

The following table lists and briefly describes the base templates used in the CTF.

<table>
<thead>
<tr>
<th>Template</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
<td>A top-level template to generate member variables from UML attributes.</td>
</tr>
<tr>
<td>Attribute Declaration</td>
<td>Used by the Attribute template to generate a member variable declaration.</td>
</tr>
<tr>
<td>Attribute Notes</td>
<td>Used by the Attribute template to generate member variable notes.</td>
</tr>
<tr>
<td>Class</td>
<td>A top-level template for generating Classes from UML Classes.</td>
</tr>
<tr>
<td>Class Base</td>
<td>Used by the Class template to generate a base Class name in the inheritance list of a derived Class, where the base Class doesn't exist in the model.</td>
</tr>
<tr>
<td>Class Body</td>
<td>Used by the Class template to generate the body of a Class.</td>
</tr>
<tr>
<td>Class Declaration</td>
<td>Used by the Class template to generate the declaration of a Class.</td>
</tr>
<tr>
<td>Class Interface</td>
<td>Used by the Class template to generate an interface name in the inheritance list of a derived Class, where the interface doesn't exist in the model.</td>
</tr>
<tr>
<td>Class Notes</td>
<td>Used by the Class template to generate the Class notes.</td>
</tr>
<tr>
<td>File</td>
<td>A top-level template for generating the source file. For languages such as C++, this corresponds to the header file.</td>
</tr>
<tr>
<td>Import Section</td>
<td>Used in the File template to generate external dependencies.</td>
</tr>
<tr>
<td>Linked Attribute</td>
<td>A top-level template for generating attributes derived from UML Associations.</td>
</tr>
<tr>
<td>Linked Attribute Notes</td>
<td>Used by the Linked Attribute template to generate the attribute notes.</td>
</tr>
<tr>
<td>Linked Attribute Declaration</td>
<td>Used by the Linked Attribute template to generate the attribute declaration.</td>
</tr>
<tr>
<td>Linked Class Base</td>
<td>Used by the Class template to generate a base Class name in the inheritance list of a derived Class, for a Class element in the model that is a parent of the current Class.</td>
</tr>
<tr>
<td>Linked Class Interface</td>
<td>Used by the Class template to generate an Interface name in the inheritance list of a derived Class, for an Interface element in the model that is a parent of the current Class.</td>
</tr>
<tr>
<td>Namespace</td>
<td>A top-level template for generating namespaces from UML packages. (Although not all languages have namespaces, this template can be used to generate an equivalent construct, such as packages in Java.)</td>
</tr>
<tr>
<td>Namespace Body</td>
<td>Used by the Namespace template to generate the body of a namespace.</td>
</tr>
<tr>
<td>Namespace Declaration</td>
<td>Used by the Namespace template to generate the namespace declaration.</td>
</tr>
<tr>
<td>Template</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Operation</td>
<td>A top-level template for generating operations from a UML Class's operations.</td>
</tr>
<tr>
<td>Operation Body</td>
<td>Used by the Operation template to generate the body of a UML operation.</td>
</tr>
<tr>
<td>Operation Declaration</td>
<td>Used by the Operation template to generate the operation declaration.</td>
</tr>
<tr>
<td>Operation Notes</td>
<td>Used by the Operation template to generate documentation for an operation.</td>
</tr>
<tr>
<td>Parameter</td>
<td>Used by the Operation Declaration template to generate parameters.</td>
</tr>
</tbody>
</table>

The second table lists templates used for generating code for languages that have separate interface and implementation sections.

<table>
<thead>
<tr>
<th>Template</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Impl</td>
<td>A top-level template for generating the implementation of a Class.</td>
</tr>
<tr>
<td>Class Body Impl</td>
<td>Used by the Class Impl template to generate the implementation of Class members.</td>
</tr>
<tr>
<td>File Impl</td>
<td>A top-level template for generating the implementation file.</td>
</tr>
<tr>
<td>File Notes Impl</td>
<td>Used by the File Impl template to generate notes in the source file.</td>
</tr>
<tr>
<td>Import Section Impl</td>
<td>Used by the File Impl template to generate external dependencies.</td>
</tr>
<tr>
<td>Operation Impl</td>
<td>A top-level template for generating operations from a UML Class's operations.</td>
</tr>
<tr>
<td>Operation Body Impl</td>
<td>Used by the Operation template to generate the body of a UML operation.</td>
</tr>
<tr>
<td>Operation Declaration Impl</td>
<td>Used by the Operation template to generate the operation declaration.</td>
</tr>
<tr>
<td>Operation Notes Impl</td>
<td>Used by the Operation template to generate documentation for an operation.</td>
</tr>
</tbody>
</table>

The base templates form a hierarchy, which varies slightly across different programming languages. A typical template hierarchy relevant to a language like C# or Java (which do not have header files) is shown in the example diagram below. In this diagram the templates are modeled as Classes (in reality they are just plain text). This hierarchy would be slightly more complicated for languages like C++ and Delphi, which have separate implementation templates.

Each of the base templates must be specialized to be of use in code engineering. In particular, each template is specialized for the supported languages (or ‘products’). For example, there is a ClassBody template defined for C++, another for C#, another for Java, and so on. By specializing the templates, you can tailor the code generated for the corresponding UML entity.

Once the base templates are specialized for a given language, they can be further specialized based on:
- A Class's stereotype
- A feature's stereotype (where the feature can be an operation or attribute)

This type of specialization enables, for example, a C# operation that is stereotyped as «property» to have a different Operation Body template from an ordinary operation. The Operation Body template can then be specialized further, based on the Class stereotype.
Note:
The above Class Model shows the hierarchy of Code Generation templates for a language such as C# or Java. The Aggregation connectors denote references between templates.

1.5.2 The Code Template Editor

The Code Template Editor provides the facilities of the Common Code Editor, including Intellisense for the various macros. For more information on Intellisense and the Common Code Editor, see the Code Editors topic in Using Enterprise Architect - UML Modeling Tool.

To access the Code Template Editor window, select the Settings | Code Generation Templates menu option.
Option | Use to
--- | ---
Language | Select the programming language.
New Language | Display the Programming Languages Datatypes dialog (see the Reference Data topic in UML Model Management), which enables you to include programming languages other than those supported for Enterprise Architect, for which to create or edit code templates.
Template | Display the contents of the active template, and provides the editor for modifying templates.
Templates | List the base code templates. The active template is highlighted. The Modified field indicates whether you have changed the default template for the current language.
Stereotype Overrides | List the stereotyped templates, for the active base template. The Modified field indicates whether you have modified a default stereotyped template.
Add New Custom Template | Invoke a dialog for creating a custom stereotyped template.
Add New Stereotyped Override | Invoke a dialog for adding a stereotyped template, for the currently selected base template.
1.5.3 Synchronize Code

Enterprise Architect uses code templates during the forward synchronization of the following programming languages:

- ActionScript
- C
- C++
- C#
- Delphi
- Java
- PHP
- Python
- VB
- VB.Net

Only a subset of the code templates are used during synchronization. This subset corresponds to the distinct sections that Enterprise Architect recognizes in the source code. The following table lists the code templates and their corresponding code sections, which can be synchronized.

<table>
<thead>
<tr>
<th>Code Template</th>
<th>Code Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Notes</td>
<td>Comments preceding Class declaration.</td>
</tr>
<tr>
<td>Class Declaration</td>
<td>Up to and including Class parents.</td>
</tr>
<tr>
<td>Attribute Notes</td>
<td>Comments preceding Attribute declaration.</td>
</tr>
<tr>
<td>Attribute Declaration</td>
<td>Up to and including terminating character.</td>
</tr>
<tr>
<td>Operation Notes</td>
<td>Comments preceding operation declaration.</td>
</tr>
<tr>
<td>Operation Notes Impl</td>
<td>As for Operation Notes.</td>
</tr>
<tr>
<td>Operation Declaration</td>
<td>Up to and including terminating character.</td>
</tr>
<tr>
<td>Operation Declaration Impl</td>
<td>Up to and including terminating character.</td>
</tr>
<tr>
<td>Operation Body</td>
<td>Everything between and including the braces.</td>
</tr>
<tr>
<td>Operation Body Impl</td>
<td>As for Operation Body.</td>
</tr>
</tbody>
</table>

Three types of change can occur in the source when it is synchronized with the UML model:
• **Synchronize Existing Sections** for example, changing the return type in an operation declaration
• **Add New Sections to Existing Features** for example, adding notes to a Class declaration, where there were previously none
• **Add New Features and Elements** for example, adding a new operation to a Class.

Each of these changes must be handled differently by Enterprise Architect; their effect on the CTF is described in the linked topics above.

### 1.5.3.1 Synchronize Existing Sections

When an existing section in the source code differs from the result generated by the corresponding template, that section is replaced. Consider for example, the following C++ Class declaration:

```
[asm] class A: public B
```

Now assume you add an inheritance relationship from Class A to Class C; the entire Class declaration would be replaced with something like:

```
[asm] class A: public B, public C
```

### 1.5.3.2 Add New Sections

The following can be added as new sections, to existing features in the source code:

• Class Notes
• Attribute Notes
• Operation Notes
• Operation Notes Impl
• Operation Body
• Operation Body Impl

Assume Class A from the previous example had no note when you originally generated the code. Now assume that you specify a note in the model for Class A. Enterprise Architect attempts to add the new note from the model during synchronization. It does this by executing the **Class Notes** template. To make room for the new section to be inserted, you can specify how much white space to append to the section via synchronization macros. These macros are described in *SDK for Enterprise Architect*.

### 1.5.3.3 Add New Features and Elements

The following features and elements can be added to the source code during synchronization:

• Attributes
• Inner Classes
• Operations.

These are added by executing the relevant templates for each new element or feature in the model. Enterprise Architect attempts to preserve the appropriate indenting of new features in the code, by finding the indents specified in list macros of the Class. For languages that make use of namespaces, the `synchNamespaceBodyIndent` macro is available. Classes defined within a (non-global) namespace are indented according to the value set for this macro, during synchronization. This value is ignored for Classes defined within a package setup as a root namespace, or if the **Generate Namespace** option is set to **False** in the appropriate language page (C#, C++ or VB.Net) on the Options dialog (Tools | Options | Source Code Engineering | <language>).
1.6 Modeling Conventions

In order to get the most out of the round trip engineering in Enterprise Architect, you must be familiar with the modeling conventions used when generating and reverse engineering the languages you use. This topic describes the stereotypes, Tagged Values and other conventions used in code engineering in Enterprise Architect for the following supported languages:

- **ActionScript**
- **Ada 2005** (for Systems Engineering and Ultimate editions of Enterprise Architect)
- **C**
- **C#**
- **C++**
- **Delphi**
- **Java**
- **PHP**
- **Python**
- **System C**
- **VB.Net**
- **Verilog**
- **VHDL**
- **Visual Basic**

**Note:**

Enterprise Architect incorporates a number of visibility indicators or scope values for its supported languages. These include, for:

- All languages - Public (+), Protected (#) and Private (-)
- Java - Package (-)
- Delphi - Published (*)
- C# - Internal (-), Protected Internal (*)
- ActionScript - Internal (-)
- VB.NET - Friend (-), Protected Friend (*)
- PHP - Package (-)
- Python - Package (-)
- C - Package (-)
- C++ - Package (-).
1.6.1 ActionScript Conventions

Enterprise Architect supports round trip engineering of ActionScript 2 and 3, where the following conventions are used.

### Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>literal</td>
<td>Operation</td>
<td>A literal method referred to by a variable.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A write property.</td>
</tr>
</tbody>
</table>

### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property get or property set</td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>dynamic</td>
<td>Class or Interface</td>
<td>The <code>dynamic</code> keyword.</td>
</tr>
<tr>
<td>final</td>
<td>ActionScript 3: Operation</td>
<td>The <code>final</code> keyword.</td>
</tr>
<tr>
<td>intrinsic</td>
<td>ActionScript 2: Class</td>
<td>The <code>intrinsic</code> keyword.</td>
</tr>
<tr>
<td>namespace</td>
<td>ActionScript 3: Class, Interface, Attribute, Operation</td>
<td>The namespace of the current element.</td>
</tr>
<tr>
<td>override</td>
<td>ActionScript 3: Operation</td>
<td>The <code>override</code> keyword.</td>
</tr>
<tr>
<td>prototype</td>
<td>ActionScript 3: Attribute</td>
<td>The <code>prototype</code> keyword.</td>
</tr>
<tr>
<td>rest</td>
<td>ActionScript 3: Parameter</td>
<td>The <code>rest</code> parameter ( ... ).</td>
</tr>
</tbody>
</table>

### Common Conventions

- Package qualifiers (ActionScript 2) and Packages (ActionScript 3) are generated when the current package is not a `namespace root`.
- An unspecified type is modeled as `var` or an empty `Type` field.

### ActionScript 3 Conventions

- The `Is Leaf` property of a Class corresponds to the sealed keyword
- If a `namespace` tag is specified it overrides the `Scope` that is specified.

**See Also**

- Import Source Code
- Generate Source Code
- ActionScript Options

1.6.2 Ada 2005

Ada 2005 support is available in the System Engineering and Ultimate editions of Enterprise Architect.

Enterprise Architect supports round trip engineering of Ada 2005, where the following conventions are used.
### Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>adaPackage</td>
<td>Class</td>
<td>A package specification in Ada 2005 without a tagged record.</td>
</tr>
<tr>
<td>delegate</td>
<td>Operation</td>
<td>Access to a subprogram.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Inner Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>struct</td>
<td>Inner Class</td>
<td>A record definition.</td>
</tr>
<tr>
<td>typedef</td>
<td>Inner Class</td>
<td>A type definition, subtype definition, access type definition, renaming.</td>
</tr>
</tbody>
</table>

### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discriminant</td>
<td>Inner Class with stereotype typedef</td>
<td>The type's discriminant.</td>
</tr>
<tr>
<td>IsAccess</td>
<td>Parameter</td>
<td>Determination of whether the parameter is an access variable.</td>
</tr>
<tr>
<td>InstantiatedUnitType</td>
<td>Inner Class with stereotype typedef</td>
<td>The instantiated unit's type (Package / Procedure / Function).</td>
</tr>
<tr>
<td>PartType</td>
<td>Inner Class with stereotype typedef</td>
<td>The part type (renames or new).</td>
</tr>
<tr>
<td>Type</td>
<td>Inner Class with stereotype typedef</td>
<td>If Value = SubType, set subtype.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If Value = Access, set access type.</td>
</tr>
</tbody>
</table>

### Other Conventions

- Appropriate type of source files: Ada specification file, `.ads`.
- Ada 2005 imports packages defined as either `<<adaPackage>>Class` or `Class`, based on the settings in the Ada options.
- A package in the Ada specification file is imported as a Class if it contains a Tagged Record, the name of which is governed by the options `Use Class Name for Tagged Record` and `Alternate Tagged Record Name`. All attributes defined in that Tagged Record are absorbed as the Class's attributes.
- A procedure / function in an Ada specification file is considered as the Class's member function if its first parameter satisfies the conditions specified in the options `Ref Param Style`, `Ignore Reference parametername` and `Ref parameter name`.
- The option `Define Reference for Tagged Record`, if enabled, creates a reference type for the Class, the name of which is determined by the option `Reference Type Name`.

For example: `HelloWorld.ads`

```ada
package HelloWorld is
type HelloWorld is tagged record
  Att1: Natural;
  Att3: Integer;
end record;

-- Public Functions
function MyPublicFunction (P: HelloWorld) return String;
procedure MyPublicFunction (P1: in out HelloWorld; AFlag: Boolean);

private

-- Private Functions
function MyPrivateFunction (P: HelloWorld) return String;
procedure MyPrivateFunction (P1: in out HelloWorld; AFlag: Boolean);
```

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end HelloWorld;

class Testbench

HelloWorld
+ At1: Natural
+ At3: Integer
  + MyPublicFunction(HelloWorld): String
  + MyPublicFunction(HelloWorld, Boolean): void
  - MyPrivateFunction(HelloWorld): String
  - MyPrivateFunction(HelloWorld, Boolean): void

<typedef>
HelloWorld::Ref

See Also
- Import Source Code
- Generate Source Code
- Ada 2005 Options

1.6.3 C Conventions

Note:
Separate conventions apply to Object Oriented programming in C.

Enterprise Architect supports round trip engineering of C, where the following conventions are used:

### Stereotype

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>enumeration</td>
<td>Inner Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>struct</td>
<td>Inner Class</td>
<td>A struct type.</td>
</tr>
<tr>
<td></td>
<td>Attribute</td>
<td>A keyword struct in variable definition.</td>
</tr>
<tr>
<td>typedef</td>
<td>Inner Class</td>
<td>A typedef statement, where the parent is the original type name.</td>
</tr>
<tr>
<td>union</td>
<td>Inner Class</td>
<td>A union type.</td>
</tr>
<tr>
<td></td>
<td>Attribute</td>
<td>A keyword union in variable definition.</td>
</tr>
</tbody>
</table>

### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>anonymous</td>
<td>Class also containing the</td>
<td>The name of this class being defined only by</td>
</tr>
</tbody>
</table>
### 1.6.3.1 Object Oriented Programming In C

The following conventions are used for Object-Oriented programming in C.

To configure Enterprise Architect to support Object-Oriented programming using C, you must set the **Object Oriented Support** option to **True** on the **C Specifications** page of the **Options** dialog.

### Stereotype

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>enumeration</td>
<td>Class</td>
<td>An <em>enum</em> type.</td>
</tr>
<tr>
<td>struct</td>
<td>Class</td>
<td>A <em>struct</em> type.</td>
</tr>
<tr>
<td></td>
<td>Attribute</td>
<td>A keyword <em>struct</em> in variable definition.</td>
</tr>
<tr>
<td>typedef</td>
<td>Class</td>
<td>A <em>typedef</em> statement, where the parent is the original type name.</td>
</tr>
<tr>
<td>union</td>
<td>Class</td>
<td>A <em>union</em> type.</td>
</tr>
<tr>
<td></td>
<td>Attribute</td>
<td>A keyword <em>union</em> in variable definition.</td>
</tr>
</tbody>
</table>
Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>anonymous</td>
<td>Class with stereotype of enumeration, struct or union.</td>
<td>The name of this Class being defined only by the typedef statement.</td>
</tr>
<tr>
<td>bodyLocation</td>
<td>Operation</td>
<td>The location the method body is generated to. Expected values are header, classDec or classBody.</td>
</tr>
<tr>
<td>define</td>
<td>Attribute</td>
<td>#define statement.</td>
</tr>
<tr>
<td>typedef</td>
<td>Class with stereotype of enumeration, struct or union.</td>
<td>This Class being defined in a typedef statement.</td>
</tr>
</tbody>
</table>

Object-Oriented C Code Generation for UML Model

The basic idea of implementing a UML Class in C code is to group the data variable (UML attributes) into a structure type. This structure is defined in a .h file so that it can be shared by other classes and by the client that referred to it.

An operation in a UML Class is implemented in C code as a function. The name of the function must be a fully qualified name that consists of the operation name, as well as the Class name to indicate that the operation is for that Class. A delimiter (specified in the Namespace Delimiter option on the C Specifications page) is used to join the Class name and function (operation) name.

The function in C code must also have a reference parameter to the Class object. You can modify the Reference as Operation Parameter, Reference Parameter Style and Reference Parameter Name options on the C Specifications page to support this reference parameter.

Limitations of Object-Oriented Programming in C

1. No scope mapping for an attribute: an attribute in a UML Class is mapped to a structure variable in C code, and its scope (private, protected or public) is ignored.
2. Currently an inner Class is ignored: if a UML Class is the inner Class of another UML Class, it is ignored when generating C code.
3. Initial value is ignored: the initial value of an attribute in a UML Class is ignored in generated C code.

See Also

- Import Source Code
- Generate Source Code
- C Options

1.6.4 C# Conventions

Enterprise Architect supports the round trip engineering of C#, where the following conventions are used.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>enumeration</td>
<td>Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>event</td>
<td>Operation</td>
<td>An event.</td>
</tr>
<tr>
<td>extension</td>
<td>Operation</td>
<td>A Class extension method, represented in code by a this parameter in the signature.</td>
</tr>
<tr>
<td>indexer</td>
<td>Operation</td>
<td>A property acting as an index for this Class.</td>
</tr>
<tr>
<td>partial</td>
<td>Operation</td>
<td>The partial keyword on an operation.</td>
</tr>
<tr>
<td>Stereotype</td>
<td>Applies To</td>
<td>Corresponds To</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>property</td>
<td>Operation</td>
<td>A property possibly containing both read and write code.</td>
</tr>
<tr>
<td>struct</td>
<td>Class</td>
<td>A struct type.</td>
</tr>
</tbody>
</table>

**Tagged Values**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>argumentName</td>
<td>Operation with stereotype extension</td>
<td>The name given to the this parameter.</td>
</tr>
<tr>
<td>attributeName</td>
<td>Operation with stereotype property or event</td>
<td>The name of the variable behind this property or event.</td>
</tr>
<tr>
<td>className</td>
<td>Operation with stereotype extension</td>
<td>The Class that this method is being added to.</td>
</tr>
<tr>
<td>const</td>
<td>Attribute</td>
<td>The const keyword.</td>
</tr>
<tr>
<td>definition</td>
<td>Operation with stereotype partial</td>
<td>Whether this is the declaration of the method, or the definition.</td>
</tr>
<tr>
<td>delegate</td>
<td>Operation</td>
<td>The delegate keyword.</td>
</tr>
<tr>
<td>enumType</td>
<td>Operation with stereotype property</td>
<td>The datatype that the property is represented as.</td>
</tr>
<tr>
<td>extern</td>
<td>Operation</td>
<td>The extern keyword.</td>
</tr>
<tr>
<td>generic</td>
<td>Operation</td>
<td>The generic parameters for this Operation.</td>
</tr>
<tr>
<td>genericConstraints</td>
<td>Templated Class or Interface, Operation with tag generic</td>
<td>The constraints on the generic parameters of this type or operation.</td>
</tr>
<tr>
<td>Implements</td>
<td>Operation</td>
<td>The name of the method this implements, including the interface name.</td>
</tr>
<tr>
<td>ImplementsExplicit</td>
<td>Operation</td>
<td>The presence of the source interface name in this method declaration.</td>
</tr>
<tr>
<td>initializer</td>
<td>Operation</td>
<td>A constructor initialization list.</td>
</tr>
<tr>
<td>new</td>
<td>Class, Interface, Operation</td>
<td>The new keyword.</td>
</tr>
<tr>
<td>override</td>
<td>Operation</td>
<td>The override keyword.</td>
</tr>
<tr>
<td>params</td>
<td>Parameter</td>
<td>A parameter list using the params keyword.</td>
</tr>
<tr>
<td>partial</td>
<td>Class, Interface</td>
<td>The partial keyword.</td>
</tr>
<tr>
<td>readonly</td>
<td>Operation with stereotype property</td>
<td>This property only defining read code.</td>
</tr>
<tr>
<td>sealed</td>
<td>Operation</td>
<td>The sealed keyword.</td>
</tr>
<tr>
<td>static</td>
<td>Class</td>
<td>The static keyword.</td>
</tr>
<tr>
<td>unsafe</td>
<td>Class, Interface, Operation</td>
<td>The unsafe keyword.</td>
</tr>
<tr>
<td>virtual</td>
<td>Operation</td>
<td>The virtual keyword.</td>
</tr>
</tbody>
</table>

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### Other Conventions

- **Namespaces** are generated for each package below a `namespace root`.
- The `Const` property of an attribute corresponds to the `readonly` keyword, while the tag `const` corresponds to the `const` keyword.
- The value of `inout` for the `Kind` property of a parameter corresponds to the `ref` keyword.
- The value of `out` for the `Kind` property of a parameter corresponds to the `out` keyword.
- Partial Classes can be modeled as two separate Classes with the `partial` tag.
- The `Is Leaf` property of a Class corresponds to the `sealed` keyword.

#### See Also

- Import Source Code
- Generate Source Code
- C# Options

### 1.6.5 C++ Conventions

Enterprise Architect supports round trip engineering of C++, including the Managed C++ and C++/CLI extensions, where the following conventions are used.

#### Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>enumeration</td>
<td>Class</td>
<td>An <code>enum</code> type.</td>
</tr>
<tr>
<td>friend</td>
<td>Operation</td>
<td>The <code>friend</code> keyword.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A write property.</td>
</tr>
<tr>
<td>struct</td>
<td>Class</td>
<td>A <code>struct</code> type.</td>
</tr>
<tr>
<td>typedef</td>
<td>Class</td>
<td>A <code>typedef</code> statement, where the parent is the original type name.</td>
</tr>
<tr>
<td>union</td>
<td>Class</td>
<td>A <code>union</code> type.</td>
</tr>
</tbody>
</table>

#### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>afx_msg</td>
<td>Operation</td>
<td>The <code>afx_msg</code> keyword.</td>
</tr>
<tr>
<td>anonymous</td>
<td>Class also containing the Tagged Value <code>typedef</code></td>
<td>The name of this class being only defined by the <code>typedef</code> statement.</td>
</tr>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype <code>property get</code> or <code>property set</code></td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>bitfield</td>
<td>Attribute</td>
<td>The size, in bits, allowed for storage of this attribute.</td>
</tr>
<tr>
<td>bodyLocation</td>
<td>Operation</td>
<td>The exceptions that are thrown by this method.</td>
</tr>
</tbody>
</table>
### 1.6.5.1 Managed C++ Conventions

The following conventions are used for managed extensions to C++ prior to C++/CLI. In order to set Enterprise Architect to generate managed C++ you must modify the C++ version in the C++ Options.

#### Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>property</td>
<td>Operation</td>
<td>The __property keyword.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>The __property keyword and a read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>The __property keyword and a write property.</td>
</tr>
<tr>
<td>reference</td>
<td>Class</td>
<td>The __gc keyword.</td>
</tr>
<tr>
<td>value</td>
<td>Class</td>
<td>The __value keyword.</td>
</tr>
</tbody>
</table>
Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>managedType</td>
<td>Class with stereotype reference, value or enumeration; Interface</td>
<td>The keyword used in declaration of this type. Expected values are class or struct.</td>
</tr>
</tbody>
</table>

Other Conventions

- The typedef and anonymous tags from native C++ are not supported
- The Pure property of an operation corresponds to the keyword __abstract.

See Also

- Import Source Code
- Generate Source Code

1.6.5.2 C++/CLI Conventions

The following conventions are used for modeling C++/CLI extensions to C++. In order to set Enterprise Architect to generate managed C++/CLI you must modify the C++ version in the C++ Options.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>event</td>
<td>Operation</td>
<td>Defines an event to provide access to the event handler for this Class.</td>
</tr>
<tr>
<td>property</td>
<td>Operation, Attribute</td>
<td>This is a property possibly containing both read and write code.</td>
</tr>
<tr>
<td>reference</td>
<td>Class</td>
<td>Corresponds to the ref class or ref struct keyword.</td>
</tr>
<tr>
<td>value</td>
<td>Class</td>
<td>Corresponds to the value class or value struct keyword.</td>
</tr>
</tbody>
</table>

Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property or event</td>
<td>The name of the variable behind this property or event.</td>
</tr>
<tr>
<td>generic</td>
<td>Operation</td>
<td>Defines the generic parameters for this Operation.</td>
</tr>
<tr>
<td>genericConstraints</td>
<td>Templated Class or Interface, Operation with tag generic</td>
<td>Defines the constraints on the generic parameters for this Operation.</td>
</tr>
<tr>
<td>initonly</td>
<td>Attribute</td>
<td>Corresponds to the initonly keyword.</td>
</tr>
<tr>
<td>literal</td>
<td>Attribute</td>
<td>Corresponds to the literal keyword.</td>
</tr>
<tr>
<td>managedType</td>
<td>Class with stereotype reference, value or enumeration; Interface</td>
<td>Corresponds to either the class or struct keyword.</td>
</tr>
</tbody>
</table>

Other Conventions

- The typedef and anonymous tags are not used
- The property get/property set stereotypes are not used
- The Pure property of an operation corresponds to the keyword abstract.
1.6.6 Delphi Conventions

Enterprise Architect supports round trip engineering of Delphi, where the following conventions are used.

**Stereotypes**

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>constructor</td>
<td>Operation</td>
<td>A constructor.</td>
</tr>
<tr>
<td>destructor</td>
<td>Operation</td>
<td>A destructor.</td>
</tr>
<tr>
<td>dispinterface</td>
<td>Class, Interface</td>
<td>A dispatch interface.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Class</td>
<td>An enumerated type.</td>
</tr>
<tr>
<td>operator</td>
<td>Operation</td>
<td>An operator.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A write property.</td>
</tr>
<tr>
<td>struct</td>
<td>Class</td>
<td>A record type.</td>
</tr>
</tbody>
</table>

**Tagged Values**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property get or property set</td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>overload</td>
<td>Operation</td>
<td>The overload keyword.</td>
</tr>
<tr>
<td>override</td>
<td>Operation</td>
<td>The override keyword.</td>
</tr>
<tr>
<td>packed</td>
<td>Class</td>
<td>The packed keyword.</td>
</tr>
<tr>
<td>property</td>
<td>Class</td>
<td>A property. See Delphi Properties for more information.</td>
</tr>
<tr>
<td>reintroduce</td>
<td>Operation</td>
<td>The reintroduce keyword.</td>
</tr>
</tbody>
</table>

**Other Conventions**

- The `Static` property of an attribute or operation corresponds to the `class` keyword
- The `Fixed` property of a parameter corresponds to the `const` keyword
- The value of `inout` for the `Kind` property of a parameter corresponds to the `Var` keyword
- The value of `out` for the `Kind` property of a parameter corresponds to the `Out` keyword.

See Also
- Import Source Code
- Generate Source Code
- Delphi Options
1.6.7 Java Conventions

Enterprise Architect supports round trip engineering of Java - including AspectJ extensions - where the following conventions are used.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>annotation</td>
<td>Interface</td>
<td>An annotation type.</td>
</tr>
<tr>
<td>enum</td>
<td>Attributes within a Class stereotyped enumeration</td>
<td>An enumerated option, distinguished from other attributes that have no stereotype.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>operator</td>
<td>Operation</td>
<td>An operator.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A write property.</td>
</tr>
<tr>
<td>static</td>
<td>Class or Interface</td>
<td>The static keyword.</td>
</tr>
</tbody>
</table>

Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>annotations</td>
<td>Anything</td>
<td>The annotations on the current code feature.</td>
</tr>
<tr>
<td>arguments</td>
<td>Attribute with stereotype enum</td>
<td>The arguments that apply to this enumerated value.</td>
</tr>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property get or property set</td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>dynamic</td>
<td>Class or Interface</td>
<td>The dynamic keyword.</td>
</tr>
<tr>
<td>generic</td>
<td>Operation</td>
<td>The generic parameters to this operation.</td>
</tr>
<tr>
<td>parameterList</td>
<td>Parameter</td>
<td>A parameter list with the ... syntax.</td>
</tr>
<tr>
<td>throws</td>
<td>Operation</td>
<td>The exceptions that are thrown by this method.</td>
</tr>
<tr>
<td>transient</td>
<td>Attribute</td>
<td>The transient keyword.</td>
</tr>
</tbody>
</table>

Other Conventions

- Package statements are generated when the current package is not a namespace root.
- The Const property of an attribute or operation corresponds to the final keyword.
- The Transient property of an attribute corresponds to the volatile keyword.
- The Fixed property of a parameter corresponds to the final keyword.

See Also

- Import Source Code
- Generate Source Code
- Java Options
1.6.7.1  AspectJ Conventions

The following are the conventions used for supporting AspectJ extensions to Java.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>advice</td>
<td>Operation</td>
<td>A piece of advice in an AspectJ aspect.</td>
</tr>
<tr>
<td>aspect</td>
<td>Class</td>
<td>An AspectJ aspect.</td>
</tr>
<tr>
<td>pointcut</td>
<td>Operation</td>
<td>A pointcut in an AspectJ aspect.</td>
</tr>
</tbody>
</table>

Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>className</td>
<td>Attribute or operation within a Class stereotyped aspect</td>
<td>The Classes this AspectJ intertype member belongs to.</td>
</tr>
</tbody>
</table>

Other Conventions

- The specifications of a pointcut are included in the Behavior field of the method.

See Also

- Import Source Code
- Generate Source Code

1.6.8  PHP Conventions

Enterprise Architect supports the round trip engineering of PHP 4 and 5, where the following conventions are used.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A read property.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A write property.</td>
</tr>
</tbody>
</table>

Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property get or property set</td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>final</td>
<td>Operations in PHP 5.</td>
<td>The final keyword.</td>
</tr>
</tbody>
</table>

Common Conventions

- An unspecified type is modeled as var
- Methods returning a reference are generated by setting the Return Type to var*
- Reference parameters are generated from parameters with the parameter Kind set to inout or out.

PHP 5 Conventions

- The final Class modifier corresponds to the Is Leaf property
- The abstract Class modifier corresponds to the Abstract property
Parameter type hinting is supported by setting the Type of a parameter. The value of inout or out for the Kind property of a parameter corresponds to a reference parameter.

**See Also**
- Import Source Code
- Generate Source Code
- PHP Options

### 1.6.9 Python Conventions

Enterprise Architect supports the round trip engineering of Python, where the following conventions are used.

**Tagged values**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>decorators</td>
<td>Class, Operation</td>
<td>The decorators applied to this element in the source.</td>
</tr>
</tbody>
</table>

**Other Conventions**
- Model members with Private Scope correspond to code members with two leading underscores.
- Attributes are only generated when the Initial value is not empty.
- All types are reverse engineered as var.

**See Also**
- Import Source Code
- Generate Source Code
- Python Options

### 1.6.10 System C Conventions

Enterprise Architect supports round-trip engineering of SystemC, where the following conventions are used.

**Stereotypes**

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>delegate</td>
<td>Method</td>
<td>A delegate.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Inner Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>friend</td>
<td>Method</td>
<td>A friend method.</td>
</tr>
<tr>
<td>property</td>
<td>Method</td>
<td>A property definition.</td>
</tr>
<tr>
<td>sc ctor</td>
<td>Method</td>
<td>A SystemC constructor.</td>
</tr>
<tr>
<td>sc module</td>
<td>Class</td>
<td>A SystemC module.</td>
</tr>
<tr>
<td>sc port</td>
<td>Attribute</td>
<td>A port.</td>
</tr>
<tr>
<td>sc signal</td>
<td>Attribute</td>
<td>A signal</td>
</tr>
<tr>
<td>struct</td>
<td>Inner Class</td>
<td>A struct or union.</td>
</tr>
</tbody>
</table>
Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind</td>
<td>Attribute (Port)</td>
<td>Port kind (clocked, fifo, master, slave, resolved, vector).</td>
</tr>
<tr>
<td>mode</td>
<td>Attribute (Port)</td>
<td>Port mode (in, out, inout).</td>
</tr>
<tr>
<td>overrides</td>
<td>Method</td>
<td>The Inheritance list of a method declaration.</td>
</tr>
<tr>
<td>throw</td>
<td>Method</td>
<td>The exception specification of a method.</td>
</tr>
</tbody>
</table>

Other Conventions

- SystemC also inherits most of the stereotypes and Tagged Values of C++.

SystemC Toolbox Pages

To access the SystemC pages of the Enterprise Architect UML Toolbox, select the More tools | HDL | SystemC Constructs menu option. Drag these icons onto a diagram to model a SystemC design.

<table>
<thead>
<tr>
<th>Page</th>
<th>Item</th>
<th>Use To</th>
</tr>
</thead>
<tbody>
<tr>
<td>SystemC</td>
<td>Module</td>
<td>Define a SystemC Module. An sc_module-stereotyped Class element.</td>
</tr>
<tr>
<td></td>
<td>Enumeration</td>
<td>Define an Enumerated Type. An enumeration-stereotyped Enumeration element.</td>
</tr>
<tr>
<td></td>
<td>Struct</td>
<td>Define a Structure. A struct-stereotyped Class element.</td>
</tr>
<tr>
<td>SystemC Features</td>
<td>Port</td>
<td>Define a SystemC Port. An sc_port-stereotyped attribute.</td>
</tr>
<tr>
<td></td>
<td>Signal</td>
<td>Define a SystemC Signal. An sc_signal-stereotyped attribute.</td>
</tr>
<tr>
<td></td>
<td>Constructor</td>
<td>Define a SystemC Constructor. An sc_ctor-stereotyped method.</td>
</tr>
</tbody>
</table>

See Also

- Import Source Code
- Generate Source Code
- SystemC Language Options

1.6.11 VB.Net Conventions

Enterprise Architect supports round-trip engineering of Visual Basic.Net, where the following conventions are used. Earlier versions of Visual Basic are supported as a different language.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>event</td>
<td>Operation</td>
<td>An event declaration.</td>
</tr>
</tbody>
</table>
### Stereotype

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>import</td>
<td>Operation</td>
<td>An operation to be imported from another library.</td>
</tr>
<tr>
<td>module</td>
<td>Class</td>
<td>A module.</td>
</tr>
<tr>
<td>operator</td>
<td>Operation</td>
<td>An operator overload definition.</td>
</tr>
<tr>
<td>partial</td>
<td>Operation</td>
<td>The <code>partial</code> keyword on an operation.</td>
</tr>
<tr>
<td>property</td>
<td>Operation</td>
<td>A property possibly containing both read and write code.</td>
</tr>
</tbody>
</table>

### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alias</td>
<td>Operation with stereotype <code>import</code></td>
<td>The alias for this imported operation.</td>
</tr>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype <code>property</code></td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>Charset</td>
<td>Operation with stereotype <code>import</code></td>
<td>The character set clause for this import. One of the values <code>Ansi</code>, <code>Unicode</code> or <code>Auto</code>.</td>
</tr>
<tr>
<td>delegate</td>
<td>Operation</td>
<td>The <code>Delegate</code> keyword.</td>
</tr>
<tr>
<td>enumTag</td>
<td>Operation with stereotype <code>property</code></td>
<td>The datatype that this property is represented as.</td>
</tr>
<tr>
<td>Handles</td>
<td>Operation</td>
<td>The <code>handles</code> clause on this operation.</td>
</tr>
<tr>
<td>Implements</td>
<td>Operation</td>
<td>The <code>implements</code> clause on this operation.</td>
</tr>
<tr>
<td>Lib</td>
<td>Operation with stereotype <code>import</code></td>
<td>The library this import comes from.</td>
</tr>
<tr>
<td>MustOverride</td>
<td>Operation</td>
<td>The <code>MustOverride</code> keyword.</td>
</tr>
<tr>
<td>Narrowing</td>
<td>Operation with stereotype <code>operator</code></td>
<td>The <code>Narrowing</code> keyword.</td>
</tr>
<tr>
<td>NotOverrideable</td>
<td>Operation</td>
<td>The <code>NotOverrideable</code> keyword.</td>
</tr>
<tr>
<td>Overloads</td>
<td>Operation</td>
<td>The <code>Overloads</code> keyword.</td>
</tr>
<tr>
<td>Overrides</td>
<td>Operation</td>
<td>The <code>Overides</code> keyword.</td>
</tr>
<tr>
<td>parameterArray</td>
<td>Parameter</td>
<td>A parameter list using the <code>ParamArray</code> keyword.</td>
</tr>
<tr>
<td>partial</td>
<td>Class, Interface</td>
<td>The <code>Partial</code> keyword.</td>
</tr>
<tr>
<td>readonly</td>
<td>Operation with stereotype <code>property</code></td>
<td>This property only defining read code.</td>
</tr>
<tr>
<td>shadows</td>
<td>Class, Interface, Operation</td>
<td>The <code>Shadows</code> keyword.</td>
</tr>
<tr>
<td>Shared</td>
<td>Attribute</td>
<td>The <code>Shared</code> keyword.</td>
</tr>
<tr>
<td>Widening</td>
<td>Operation with stereotype <code>operator</code></td>
<td>The <code>Widening</code> keyword.</td>
</tr>
<tr>
<td>writeonly</td>
<td>Operation with stereotype <code>property</code></td>
<td>This property only defining write code.</td>
</tr>
</tbody>
</table>

### Other Conventions

- Namespaces are generated for each package below a `namespace root`.
- The `Is Leaf` property of a Class corresponds to the `NotInheritable` keyword.
- The `Abstract` property of a Class corresponds to the `MustInherit` keyword.
- The `Static` property of an attribute or operation corresponds to the `Shared` keyword.
- The `Abstract` property of an operation corresponds to the `MustOverride` keyword.
- The value of `in` for the `Kind` property of a parameter corresponds to the `ByVal` keyword.
- The value of `inout` or `out` for the `Kind` property of a parameter corresponds to the `ByRef` keyword.

**See Also**
- Import Source Code
- Generate Source Code
- VB.Net Options

### 1.6.12 Verilog Conventions

Enterprise Architect supports round-trip engineering of Verilog, where the following conventions are used.

#### Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>asynchronous</td>
<td>Method</td>
<td>A concurrent process.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Inner Class</td>
<td>An <code>enum</code> type.</td>
</tr>
<tr>
<td>initializer</td>
<td>Method</td>
<td>An initializer process.</td>
</tr>
<tr>
<td>module</td>
<td>Class</td>
<td>A module.</td>
</tr>
<tr>
<td>part</td>
<td>Attribute</td>
<td>A component instantiation.</td>
</tr>
<tr>
<td>port</td>
<td>Attribute</td>
<td>A port.</td>
</tr>
<tr>
<td>synchronous</td>
<td>Method</td>
<td>A sequential process.</td>
</tr>
</tbody>
</table>

#### Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>kind</td>
<td>Attribute (signal)</td>
<td>The signal kind (such as <code>register</code>, <code>bus</code>).</td>
</tr>
<tr>
<td>mode</td>
<td>Attribute (port)</td>
<td>The port mode (<code>in</code>, <code>out</code>, <code>inout</code>).</td>
</tr>
<tr>
<td>Portmap</td>
<td>Attribute (part)</td>
<td>The generic / port map of the component instantiated.</td>
</tr>
<tr>
<td>sensitivity</td>
<td>Method</td>
<td>The sensitivity list of a sequential process.</td>
</tr>
<tr>
<td>type</td>
<td>Attribute</td>
<td>The range or type value of an attribute.</td>
</tr>
</tbody>
</table>

#### Verilog Toolbox Pages

To access the Verilog pages of the Enterprise Architect UML Toolbox, select the More tools | HDL | Verilog Constructs menu option. Drag these icons onto a diagram to model a Verilog design.

<table>
<thead>
<tr>
<th>Page</th>
<th>Item</th>
<th>Use To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verilog</td>
<td>Module</td>
<td>Define a Verilog Module.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A <code>module</code>-stereotyped Class element.</td>
</tr>
<tr>
<td></td>
<td>Enumeration</td>
<td>Define an Enumerated Type.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>An <code>enumeration</code>-stereotyped Class element.</td>
</tr>
</tbody>
</table>
16.13 VHDL Conventions

Enterprise Architect supports round-trip engineering of VHDL, where the following conventions are used.

**Stereotypes**

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Correlates To</th>
</tr>
</thead>
<tbody>
<tr>
<td>architecture</td>
<td>Class</td>
<td>An architecture.</td>
</tr>
<tr>
<td>asynchronous</td>
<td>Method</td>
<td>An asynchronous process.</td>
</tr>
<tr>
<td>configuration</td>
<td>Method</td>
<td>A configuration.</td>
</tr>
<tr>
<td>enumeration</td>
<td>Inner Class</td>
<td>An enum type.</td>
</tr>
<tr>
<td>entity</td>
<td>Interface</td>
<td>An entity.</td>
</tr>
<tr>
<td>part</td>
<td>Attribute</td>
<td>A component instantiation.</td>
</tr>
<tr>
<td>port</td>
<td>Attribute</td>
<td>A port.</td>
</tr>
<tr>
<td>signal</td>
<td>Attribute</td>
<td>A signal declaration.</td>
</tr>
<tr>
<td>struct</td>
<td>Inner Class</td>
<td>A record definition.</td>
</tr>
<tr>
<td>synchronous</td>
<td>Method</td>
<td>A synchronous process.</td>
</tr>
<tr>
<td>typedef</td>
<td>Inner Class</td>
<td>A type or subtype definition.</td>
</tr>
</tbody>
</table>

**Tagged Values**

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Correlates To</th>
</tr>
</thead>
<tbody>
<tr>
<td>isGeneric</td>
<td>Attribute (port)</td>
<td>The port declaration in a generic interface.</td>
</tr>
<tr>
<td>isSubType</td>
<td>Inner Class (typedef)</td>
<td>A subtype definition.</td>
</tr>
</tbody>
</table>
### Tag | Applies To | Corresponds To
--- | --- | ---
kind | Attribute (signal) | The signal kind (such as register, bus).
mode | Attribute (port) | The port mode (in, out, inout, buffer, linkage).
portmap | Attribute (part) | The generic / port map of the component instantiated.
sensitivity | Method (synchronous) | The sensitivity list of a synchronous process.
type | Inner Class (typedef) | The type indication of a type declaration.
typeNameSpace | Attribute (part) | The type namespace of the instantiated component.

**VHDL Toolbox Pages**

To access the VHDL pages of the Enterprise Architect UML Toolbox, select the More tools | HDL | VHDL Constructs menu option. Drag these icons onto a diagram to model a VHDL design.

<table>
<thead>
<tr>
<th>Page</th>
<th>Item</th>
<th>Use To</th>
</tr>
</thead>
<tbody>
<tr>
<td>VHDL</td>
<td>Architecture</td>
<td>Define an architecture to be associated with a VHDL entity. An architecture-stereotyped Class element.</td>
</tr>
<tr>
<td>Entity</td>
<td>Define a VHDL entity to contain the Port definitions. An entity-stereotyped interface element.</td>
<td></td>
</tr>
<tr>
<td>Enumeration</td>
<td>Define an Enumerated Type. An enumeration-stereotyped enumeration element.</td>
<td></td>
</tr>
<tr>
<td>Struct</td>
<td>Define a VHDL record. A struct-stereotyped Class element.</td>
<td></td>
</tr>
<tr>
<td>Typedef</td>
<td>Define a VHDL type or subtype. A typedef-stereotyped Class element.</td>
<td></td>
</tr>
<tr>
<td>VHDL Features</td>
<td>Port</td>
<td>Define a VHDL Port. A port-stereotyped attribute.</td>
</tr>
<tr>
<td>Part</td>
<td>Define a VHDL component instantiation. A part-stereotyped attribute.</td>
<td></td>
</tr>
<tr>
<td>Signal</td>
<td>Define a VHDL signal. A signal-stereotyped attribute.</td>
<td></td>
</tr>
<tr>
<td>Procedure</td>
<td>Define a VHDL process:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Concurrent</td>
<td>An asynchronous-stereotyped method</td>
</tr>
<tr>
<td></td>
<td>• Sequential</td>
<td>A synchronous-stereotyped method</td>
</tr>
<tr>
<td></td>
<td>• Configuration</td>
<td>A configuration-stereotyped method</td>
</tr>
</tbody>
</table>

**See Also**
- Import Source Code
- Generate Source Code
- VHDL Language Options
1.6.14 Visual Basic Conventions

Enterprise Architect supports the round trip engineering of Visual Basic 5 and 6, where the following conventions are used. Visual Basic.Net is supported as a different language.

Stereotypes

<table>
<thead>
<tr>
<th>Stereotype</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>global</td>
<td>Attribute</td>
<td>The Global keyword.</td>
</tr>
<tr>
<td>import</td>
<td>Operation</td>
<td>An operation to be imported from another library.</td>
</tr>
<tr>
<td>property get</td>
<td>Operation</td>
<td>A property get.</td>
</tr>
<tr>
<td>property set</td>
<td>Operation</td>
<td>A property set.</td>
</tr>
<tr>
<td>property let</td>
<td>Operation</td>
<td>A property let.</td>
</tr>
<tr>
<td>with events</td>
<td>Attribute</td>
<td>The WithEvents keyword.</td>
</tr>
</tbody>
</table>

Tagged Values

<table>
<thead>
<tr>
<th>Tag</th>
<th>Applies To</th>
<th>Corresponds To</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alias</td>
<td>Operation with stereotype import</td>
<td>The alias for this imported operation.</td>
</tr>
<tr>
<td>attribute_name</td>
<td>Operation with stereotype property get , property set or property let</td>
<td>The name of the variable behind this property.</td>
</tr>
<tr>
<td>Lib</td>
<td>Operation with stereotype import</td>
<td>The library this import comes from.</td>
</tr>
<tr>
<td>New</td>
<td>Attribute</td>
<td>The New keyword.</td>
</tr>
</tbody>
</table>

Other Conventions

- The value of in for the Kind property of a parameter corresponds to the ByVal keyword
- The value of inout or out for the Kind property of a parameter corresponds to the ByRef keyword.

See Also

- Import Source Code
- Generate Source Code
- Visual Basic Options
2 XML Technologies

Enterprise Architect enables rapid modeling, forward engineering and reverse engineering of two key W3C XML technologies:

- **XML Schema** (XSD)
- **Web Service Definition Language** (WSDL).

XSD and WSDL support is critical for the development of a complete *Service Oriented Architecture* (SOA), and the coupling of UML 2.1 and XML provides the natural mechanism for specifying, constructing and deploying XML-based SOA artifacts within an organization.

The following topics explain how to work with these technologies using Enterprise Architect.

- **XML Schema (XSD)**
- **Web Services (WSDL)**
2.1 XML Schema (XSD)

Enterprise Architect supports Forward and Reverse engineering of W3C XML schemas (XSD). The following topics explain how to use Enterprise Architect to model, generate and import XML schemas:

- Model XSD
- Import XSD
- Generate XSD

2.1.1 Model XSD

XML schemas are modeled using UML Class diagrams (see The UML Dictionary). The XML Schema pages of the Enterprise Architect UML Toolbox (see Using Enterprise Architect - UML Modeling Tool) provide in-built support for the UML profile for XSD. This enables an abstract UML Class model to be automatically generated as a W3C XML Schema (XSD) file.

The following Class diagram models simple schema for an example Employee Details system, intended to store a company's employee contact information. The Classes shown form the EmployeeDetails package. The UML attributes of the Classes map directly to XML elements or attributes. Note that the Classes have no methods, since there is no meaningful correspondence between Class methods and XSD constructs.
The following code shows the schema generated for the Employee Details package by default. Notice how each UML Class corresponds to a complexType definition in the schema. The Class attributes are generated as schema elements contained in a Sequence model group within the definition. The Enumeration Class is the exception here - it maps directly to an XSD enumeration, contained within a simpleType definition.

```xml
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:element name="ContactInfo" type="ContactInfo"/>
  <xs:complexType name="ContactInfo">
    <xs:sequence>
      <xs:element name="ContactInfo.homePhone" type="xs:string" maxOccurs="1"/>
      <xs:element name="ContactInfo.email" type="xs:string"/>
      <xs:element name="ContactInfo.streetAddress" type="xs:string"/>
      <xs:choice>
        <xs:element name="ContactInfo.mobilePhone" type="xs:string"/>
        <xs:element name="ContactInfo.officePhone" type="xs:string"/>
      </xs:choice>
    </xs:sequence>
  </xs:complexType>
  <xs:simpleType name="Gender">
    <xs:restriction base="xs:string">
      <xs:pattern value="male|female"/>
    </xs:restriction>
  </xs:simpleType>
  <xs:complexType name="Employee">
    <xs:complexContent>
      <xs:extension base="Gender">
        <xs:restriction base="Employee">  
        </xs:restriction>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>
</xs:schema>
```
The following topics provide further explanation:

- UML Profile for XSD
- XSD Datatypes Package
- Abstract XSD Models

2.1.1.1 UML Profile for XSD

The UML Profile for XSD specifies a set of stereotypes, Tagged Values and constraints that can be applied to the UML model in order to change particular aspects of the resulting schema. For example, you might have to convert certain UML Class attributes to XSD attributes, or use a model group other than the default Sequence.

Enterprise Architect provides native support for the UML Profile for XSD via the XML schema pages of the Enterprise Architect UML Toolbox (see Using Enterprise Architect - UML Modeling Tool). Alternatively, you can use the profile via Enterprise Architect's generic profile mechanism by downloading the UML Profile for XSD. See the Using Profiles topic in Extending UML With Enterprise Architect for details on importing UML profiles into Enterprise Architect. The XSD profile used by Enterprise Architect is an adaptation of the profile defined in Modeling XML Applications with UML (David Carlson).

The XSD stereotypes provide an explicit mapping from XSD to UML constructs. The Tagged Values further define aspects of the mapping, such as whether the elements should be qualified. Full information on the Tagged Values can be obtained from the W3C XML Schema recommendation. The constraints define any conditions that must be satisfied for the stereotype to apply.

The following stereotypes are provided:

- XSInamespace
- XSDcomplexType
- XSDsimpleType
- XSDsequence
- XSDchoice
- XSDelement
- XSDattribute
The following tables list the features of the UML Profile for XSD. Tagged Value names are shown in bold followed by the allowed values. If a default value is used by Enterprise Architect's schema generator, it is underlined.

**«XSDschema»**

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>All Classes in a package are defined within one schema. This stereotype can be used to specify schema-wide settings.</td>
</tr>
<tr>
<td>Tagged Values</td>
<td></td>
</tr>
<tr>
<td>anonymousRole:</td>
<td>(true</td>
</tr>
<tr>
<td>anonymousType:</td>
<td>(true</td>
</tr>
<tr>
<td>attributeFormDefault:</td>
<td>(qualified</td>
</tr>
<tr>
<td>defaultNamespace:</td>
<td>The default namespace used in this schema. This value is used to specify the default namespace attribute (xmlns=), in the schema element.</td>
</tr>
<tr>
<td>elementDerivation:</td>
<td>(true</td>
</tr>
<tr>
<td>elementFormDefault:</td>
<td>(qualified</td>
</tr>
<tr>
<td>memberNames:</td>
<td>(qualified</td>
</tr>
<tr>
<td>modelGroup:</td>
<td>(all</td>
</tr>
<tr>
<td>schemaLocation:</td>
<td>The URI that identifies the location of the schema. This value is used in the import and include elements.</td>
</tr>
<tr>
<td>targetNamespace:</td>
<td>The URI that uniquely identifies this schema's namespace.</td>
</tr>
<tr>
<td>targetNamespacePrefix:</td>
<td>The prefix that abbreviates the targetNamespace.</td>
</tr>
<tr>
<td>version:</td>
<td>The version of this schema.</td>
</tr>
<tr>
<td>Constraints</td>
<td>None.</td>
</tr>
</tbody>
</table>

**«XSDcomplexType»**

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>complexType definitions are created for generic UML Classes.</td>
</tr>
</tbody>
</table>
This stereotypes helps tailor the generation of a complexType definition.

| **Tagged Values** | memberNames: (qualified | unqualified) | Determines whether elements generated from the UML Class attributes and associations have their name qualified by the corresponding Class name for this complexType definition. |
|-------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
|                   | mixed: (true | false) | Determines whether this element can contain mixed element and character content. See the W3C XML Schema recommendation. |
|                   | modelGroup: (all | sequence | choice) | Overrides the default XSD model for generating this complexType definition. |

Constraints

None.

**«XSDsimpleType»**

<table>
<thead>
<tr>
<th><strong>UML Construct</strong></th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>An XSD simpleType is generated for Classes with this stereotype.</td>
</tr>
<tr>
<td><strong>Tagged Values</strong></td>
<td>derivation: (restriction</td>
</tr>
<tr>
<td></td>
<td>length:</td>
</tr>
<tr>
<td></td>
<td>minLength:</td>
</tr>
<tr>
<td></td>
<td>maxLength:</td>
</tr>
<tr>
<td></td>
<td>minInclusive:</td>
</tr>
<tr>
<td></td>
<td>minExclusive:</td>
</tr>
<tr>
<td></td>
<td>maxInclusive:</td>
</tr>
<tr>
<td></td>
<td>maxExclusive:</td>
</tr>
<tr>
<td></td>
<td>totalDigits:</td>
</tr>
<tr>
<td></td>
<td>fractionDigits:</td>
</tr>
<tr>
<td></td>
<td>whiteSpace:</td>
</tr>
<tr>
<td></td>
<td>pattern:</td>
</tr>
</tbody>
</table>

Constraints

This Class can only participate in an inheritance relation with another simpleType. It cannot have any attributes or own any associations; they are ignored if present.

**«XSDsequence»**

<table>
<thead>
<tr>
<th><strong>UML Construct</strong></th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>The schema generator creates a sequence model group as the container for the attributes and associations owned by this Class. The model group is in turn added to the model groups of</td>
</tr>
</tbody>
</table>

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this Class respective owners.

**Note:**
Tagged values specified by owners of this Class persist through to the child elements of this model group. Thus if memberNames are unqualified for a complexType, so are the children of this model group when added to that complexType.

| Tagged Values | None. |
| Constraints | This Class must be the destination of unidirectional associations. If it is not, this Class and its connectors are ignored, possibly invalidating other model group Classes. Inheritance relations are ignored for this Class. |

**«XSDchoice»**

| UML Construct | Class |
| **Description** | Creates an XSD choice element. See XSDsequence for more details. |
| **Tagged Values** | None. |
| **Constraints** | As for XSDsequence. |

**«XSDelement»**

| UML Construct | Attribute: AssociationEnd |
| **Description** | By applying this stereotype to a UML Class attribute or AssociationEnd, the corresponding UML entity is generated as an element within the parent complexType and not as an XSD attribute. |
| **Tagged Values** | form: (qualified | unqualified) |
| | Overrides the schema’s elementFormDefault value. |
| | position: |
| | Causes the elements to be ordered within a sequence model group of the containing complexType. Duplicated and invalid position Tagged Values are ignored and result in undefined ordering of the UML attributes. Missing position values cause the defined positions to be allocated as specified, with the remaining elements filling the missing positions in an undefined order. |
| anonymousRole: (true | false) | Specifies if the role name is included in the element declaration for the UML attribute. |
| anonymousType: (true | false) | Specifies whether the Class type is anonymous for attributes. |
| default | See the W3C XML Schema recommendation. |
| fixed | None. |

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### «XSDattribute»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Attribute: <code>AssociationEnd</code></th>
</tr>
</thead>
</table>

**Description**
By applying this stereotype to a UML Class attribute or `AssociationEnd`, the corresponding UML entity is generated as an XSD attribute within the parent `complexType` and not as an XSD element.

**Tagged Values**

<table>
<thead>
<tr>
<th>form: (qualified</th>
<th>unqualified)</th>
<th>Overrides the schema’s <code>attributeFormDefault</code> value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>use: (prohibited</td>
<td>optional</td>
<td>required)</td>
</tr>
<tr>
<td>default</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fixed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Constraints**
The attribute `datatype` should not see a Class specification, otherwise it is ignored.

### «XSDany»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class: <code>Attribute</code></th>
</tr>
</thead>
</table>

**Description**
If applied to a UML attribute, an XSD `anyAttribute` element is generated. If applied to a UML Class, an XSD `any` element is generated.

**Tagged Values**

<table>
<thead>
<tr>
<th>namespace:</th>
<th>See the W3C XML Schema recommendation.</th>
</tr>
</thead>
</table>

**Constraints**
None.

### «XSDrestriction»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Generalization</th>
</tr>
</thead>
</table>

**Description**
 Overrides the default use of XSD extension for inheritance and generates the child as a `complexType` with a restriction element instead.

**Tagged Values**
None.

**Constraints**
Applies only to UML Class parent-child relations.

### «XSDgroup»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class</th>
</tr>
</thead>
</table>

---

*Code Engineering Using UML Models*
### XSDgroup

<table>
<thead>
<tr>
<th>Description</th>
<th>An XSDgroup is generated for Classes with this stereotype.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tagged Values</td>
<td><strong>modelGroup:</strong> (sequence</td>
</tr>
<tr>
<td>Constraints</td>
<td>A group Class can only associate itself to other group Classes. A group Class can be associated by another group Class or a <code>complexType</code> Class. The association should be via an Association connector. A group Class cannot be inherited/aggregated.</td>
</tr>
</tbody>
</table>

#### «XSDtopLevelElement»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Creates an <code>&lt;xs:element&gt;</code> construct which acts as a container for <code>XSDcomplexType</code> and <code>XSDsimpleType</code> Class.</td>
</tr>
<tr>
<td>Tagged Values</td>
<td><strong>default</strong> <strong>See the W3C XML Schema recommendation.</strong> <strong>fixed</strong></td>
</tr>
<tr>
<td>Constraints</td>
<td>An <code>XSDtopLevelElement</code> Class can contain either an <code>XSDsimpleType</code> or an <code>XSDcomplexType</code> as its child Class. When such a Class is present as its child, all its inheritance is ignored. This Class cannot be inherited.</td>
</tr>
</tbody>
</table>

#### «XSDtopLevelAttribute»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Creates an <code>&lt;xs:attribute&gt;</code> construct which acts as a container for <code>XSDsimpleType</code> Class.</td>
</tr>
<tr>
<td>Tagged Values</td>
<td><strong>use:</strong> (optional</td>
</tr>
<tr>
<td>Constraints</td>
<td>An <code>XSDtopLevelAttribute</code> Class can contain only an <code>XSDsimpleType</code> Class as its child Class. When such a Class is present as its child, all its inheritance is ignored. This Class can inherit from only one <code>XSDsimpleType</code> Class.</td>
</tr>
</tbody>
</table>

#### «XSDunion»

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Creates an <code>&lt;xs:union&gt;</code> construct which can act as a container for <code>XSDsimpleType</code> Class.</td>
</tr>
</tbody>
</table>
An XSDunion Class can contain only XSDsimpleType as its child Class and can generalize from other XSDsimpleType Classes only. All the Classes that this Class generalizes become the members of the attribute memberTypes. This Class cannot have any attributes or associations.

**2.1.1.2 XSD Datatypes Package**

When modeling XSD constructs, it is often useful to have the XSD primitive types represented as UML elements. In this way user-defined types, for example, can reference the datatype elements as part of inheritance or association relationships.

Sparx Systems provides the set of primitive XSD data types as a UML package in the form of an XMI file. Each of the XSD primitive types is represented by a UML Class in a package named XSDDatatypes. To import the XSDDatatypes package into your model, follow the steps below:

1. Download the XSDDatatypes package using the following link: XSDDatatypes Package. The file XSDDatatypes.xml is an XMI file.
2. Use Enterprise Architect's XMI import facility, which is available via the Project | Import/Export | Import Package from XMI menu option. See the Import XMI topic in UML Model Management.
3. When the XMI import is complete, you have the UML package named XSDDatatypes in your model, from which you can drag and drop the relevant types as required.

**2.1.1.3 Abstract XSD models**

XML schemas can be modeled using simple, abstract Class models. This can be useful in enabling an architect to start work at a higher level of abstraction, without concern for the implementation details of a schema. Such an abstract model can be refined further using the XML Schema pages of the Enterprise Architect UML Toolbox (see Using Enterprise Architect - UML Modeling Tool), or it can be generated directly by Enterprise Architect's schema generator. In this case, a set of default mappings is assumed by the schema generator to convert the abstract model to an XSD file.

The following is a simplified version of the Employee Details example model, which does not use XSD-specific stereotypes or Tagged Values.
The following schema fragment would be generated by Enterprise Architect, given the above model.

```xml
<?xml version="1.0"?>
<xs:schema xmlns:xs="http://www.w3.org/2001/XMLSchema">
  <xs:simpleType name="Status">
    <xs:restriction base="xs:string">
      <xs:enumeration value="Full-Time"/>
      <xs:enumeration value="Part-Time"/>
      <xs:enumeration value="Casual"/>
      <xs:enumeration value="Contract"/>
    </xs:restriction>
  </xs:simpleType>

  <xs:element name="Person" type="Person"/>

  <xs:complexType name="Person">
    <xs:sequence>
      <xs:element name="firstName" type="xs:string"/>
      <xs:element name="surName" type="xs:string"/>
      <xs:element name="birthDate" type="xs:string"/>
      <xs:element name="gender" type="xs:string"/>
      <xs:element name="contactDetails" type="ContactInfo"/>
    </xs:sequence>
  </xs:complexType>

  <xs:element name="Employee" type="Employee"/>

  <xs:complexType name="Employee">
    <xs:complexContent>
      <xs:extension base="Person">
        <xs:sequence>
          <xs:element name="status" type="Status"/>
          <xs:element name="jobTitle" type="xs:string"/>
          <xs:element name="startDate" type="xs:dateTime"/>
          <xs:element name="department" type="xs:string"/>
        </xs:sequence>
      </xs:extension>
    </xs:complexContent>
  </xs:complexType>

  <xs:element name="EmployeeRecords" type="EmployeeRecords"/>
  <xs:complexType name="EmployeeRecords">
    <xs:sequence>
      <xs:element name="Employee" type="Employee" minOccurs="0" maxOccurs="unbounded"/>
    </xs:sequence>
  </xs:complexType>

  <xs:element name="ContactInfo" type="ContactInfo"/>
  <xs:complexType name="ContactInfo">
    <xs:sequence>
      <xs:element name="email" type="xs:string"/>
      <xs:element name="homePhone" type="xs:string"/>
      <xs:element name="mobilePhone" type="xs:string"/>
      <xs:element name="officePhone" type="xs:string"/>
      <xs:element name="streetAddress" type="xs:string"/>
    </xs:sequence>
  </xs:complexType>
</xs:schema>
```
2.1.1.3.1 Default UML to XSD Mappings

The following table describes the default mapping of UML to XSD constructs. This set of mappings is useful when defining simple schemas from abstract Class models. The defaults are also assumed by the schema generator when generating un stereotyped elements in an abstract model. The XML Schema pages of the Enterprise Architect UML Toolbox (and UML Profile for XSD) override these default mappings through the use of stereotypes and Tagged Values.

<table>
<thead>
<tr>
<th>UML Construct</th>
<th>Default XSD Production Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>A schema element is generated for the target package. If the target package includes Classes from another package, which has the Tagged Values targetNamespace and targetNamespacePrefix set, these are included as attributes of the schema element. In addition, an import or include element is created for each referenced package. (An include element is used if the external package shares the same targetNamespace Tagged Value as the target package. An import element is used where the targetNamespaces differ).</td>
</tr>
<tr>
<td>Class</td>
<td>A root-level element declaration and complexType definition are generated. The element name and type are the same as the Class name. An XSD sequence model group is generated to contain UML attributes generated as elements.</td>
</tr>
<tr>
<td>Attribute</td>
<td>An element is declared for each Class attribute. The element name is set to that of the UML attribute name. This is prefixed with the Class name to make the element unique. The minOccurs and maxOccurs attributes are set to reflect the attribute cardinality. Note: If left unspecified, minOccurs and maxOccurs default to 1.</td>
</tr>
<tr>
<td>Association</td>
<td>An element is declared for each association owned by a Class. The element name is set to that of the association role. The minOccurs and maxOccurs reflect the cardinality of the association. Note: If the direction of the association is unspecified, the owner is assumed to be the source.</td>
</tr>
<tr>
<td>Generalization</td>
<td>For single inheritances, an extension element is generated with the base attribute set to the base Classname. The UML attributes of the child Class are then appended to an all model group within the extension element.</td>
</tr>
<tr>
<td>«enumeration»</td>
<td>A simpleType element is declared for the enumeration Class with the name attribute set to the Classname. A restriction element is generated with base set to string. Each of the Class attributes is appended to the restriction element as XSD enumeration elements with value set to the UML attribute name. Any type specification for the UML attributes is ignored by the schema generator.</td>
</tr>
</tbody>
</table>
### 2.1.2 Generate XSD

The Generate XML Schema feature forward engineers a UML Class model to a W3C XML Schema (XSD) file. An XML schema corresponds to a UML package in Enterprise Architect, therefore XML schema generation is a package-level operation. To generate an XML schema from a package, follow the steps below:

1. In the Project Browser, right-click on the package to be converted to XSD. The context menu displays.
2. Select the Code Engineering | Generate XML Schema menu option. The Generate XML Schema dialog displays, showing the name of the selected package in the Source Package field.

![Generate XML Schema dialog](image)

3. In the Encoding field, set the required XML encoding.
4. In the XSD Style panel, the Generate global element for all global ComplexTypes checkbox is selected by default to generate schema in the Garden of Eden style.
5. In the Referenced Package Options panel, select the:
   - Generate XSD for Referenced packages checkbox to generate schema for packages that are referenced by any of the packages selected in the list box
   - Prompt when missing Filename checkbox to enable Enterprise Architect to prompt for a filename for a referenced package during schema generation, if the filename is missing.
6. In the Child Package Options panel, select the:
   - Generate XSD for Child Packages checkbox to generate schema for child packages of the selected package
   - Include all packages radio button to list all child packages under the parent package in the list box
   - Include <XSDschema> packages radio button to list only those packages that have the stereotype «XSDschema»

   The list box displays, for each package, the package name and the file path where the schema file is to be generated.

7. If it is necessary to change the file path for a package, double-click on the entry in the list box and, on the Select XML File dialog, type or select the appropriate file path.

8. Ensure that the checkbox is selected for each package required for generation.

9. Click on the Generate button to generate the schema for each of the selected packages.

10. The progress of the schema generator is shown in the Progress box.

11. When schema generation is complete, click on an entry in the list box and click on the View Schema button to review the generated schema.

**Tip:**

The Generate XML Schema dialog can also be accessed from the active diagram by selecting the Project | XML Schema | Generate XML Schema menu option.

### 2.1.2.1 Generate Global Element

Enterprise Architect, by default, generates XML Schema in the Garden of Eden style. For every global `XSDcomplexType` stereotyped Class, Enterprise Architect generates a global element. For example, the following model by default generates the XSD shown:

You can change this default behaviour by deselecting the Generate global element for all global ComplexTypes checkbox on the Generate XML Schema dialog. Then, the generated XSD no longer contains the global element, as shown below:
2.1.3 Import XSD

The XML Schema Import facility is used to reverse engineer a W3C XML Schema (XSD) file as a UML Class model. An XSD file is imported into Enterprise Architect as a UML package. To import an XSD file, follow the steps below:

1. In the Project Browser, right-click on the package to contain the imported XSD package. The context menu displays.
3. In the Directory field, click on the [...] (Browse) button. The Select XML Schema(s) dialog displays.
4. Click on the required input file. To select several individual files, press [Ctrl] as you click on each one. To select a range of files, press [Shift] and click on the first and last file in the range.
5. Click on the Open button to return to the Import XML Schema dialog, which now shows the selected files in the Selected File(s) field.
6. The Import global elements with "Type" postfix checkbox defaults to unselected to import a global element, and the ComplexType to which it refers, as a single ComplexType Class.
7. The Import referenced XML Schema(s) checkbox defaults to selected, to import any other Schema file referenced by the selected input XML Schema file or files.

**Note:**

If an XML Schema file being imported already exists in the model, Enterprise Architect skips importing the file.

8. The Create Diagram for XML Schema(s) checkbox defaults to selected, to display the imported elements on the diagram. If necessary, deselect the checkbox.
9. For the Import XSD Elements/Attributes as: field, select the appropriate radio button to import elements and attributes in the XML Schema as:
   - UML Association connectors or
   - UML Class attributes.
10. Click on the Import button to import the schema.
11. The progress of the schema import is shown in the Progress status bar.
Tip:
The Import XML Schema dialog can also be accessed for the active diagram by selecting the Project | XML Schema | Import XML Schema menu option.

Note:
Enterprise Architect uses the schemaLocation attribute in the Import and Include elements of an XML Schema to determine the dependencies between the files. Ensure that this attribute is set to a valid file path (and not a URL) for the dependent XML Schema(s) to be imported correctly.

### 2.1.3.1 Global Element and ComplexType

Some XML Schemas have ComplexType elements with the same name as the referring global elements, but with the suffix Type as shown below:

```xml
<xs:element name="Address" type="AddressType"/>
<xs:complexType name="AddressType">
  <xs:sequence/>
</xs:complexType>
```

On XSD import, Enterprise Architect treats this global element and its bounding ComplexType as a single entity and creates a single XSDcomplexType stereotyped Class with the same name as the global element as shown below:

You can change this default behaviour by selecting the Import global elements with "Type" postfix checkbox. When you select this option, Enterprise Architect treats the global element and the ComplexType it is referring to as two separate entities. So, for the above example, Enterprise Architect creates an XSDtopLevelElement stereotyped Class for the global element and an XSDcomplexType stereotyped Class for the ComplexType, and connects them as follows:
Note:

Enterprise Architect treats the following as two separate entities irrespective of whether the **Import global elements with "Type" postfix** checkbox is selected or unselected:

```xml
<xs:element name="HomeAddress" type="AddressType"/>
<xs:complexType name="AddressType">
  <xs:sequence/>
</xs:complexType>
```
2.2 Web Services (WSDL)

Enterprise Architect supports Forward and Reverse Engineering of the W3C Web Service Definition Language (WSDL). The following topics explain how to use Enterprise Architect to model, generate and import WSDL files:

- Model WSDL
- Import WSDL
- Generate WSDL

2.2.1 Model WSDL

The WSDL pages of the Enterprise Architect UML Toolbox (see Using Enterprise Architect - UML Modeling Tool) can be used to conveniently model WSDL documents. WSDL documents are represented as components marked with the stereotype WSDL. WSDL documents are contained in a package hierarchy representing the target WSDL namespace and its constituent XSD Types, Messages, PortTypes, Bindings and Services. The top-level package is stereotyped as a WSDL namespace. The figure below shows a WSDL namespace package structure:
A **WSDL namespace** package can contain one or more WSDL components. Each WSDL component can be automatically generated to a WSDL file using Enterprise Architect's built in **WSDL generator**. The following topics describe the various WSDL elements and features supported by Enterprise Architect:

- **WSDL Namespace**
- **WSDL Document**
- **WSDL Service**
- **WSDL Port Type**
- **WSDL Message**
- **WSDL Binding**
- **WSDL Port Type Operation**
2.2.1.1 WSDL Namespace

The WSDL namespace in Enterprise Architect represents the top-level container for the WSDL elements, including WSDL documents. Conceptually it maps to the `targetNamespace` in a WSDL definition element. A given WSDL namespace can reuse its schema Types, Messages, Port Types, Bindings and Service across multiple physical WSDL documents.

The figure below shows an example WSDL namespace (OnlineBookstore PSM, which has a red margin to the bottom right corner), including a single WSDL document:
To create a new WSDL namespace in your model, follow the steps below.

1. Open or create the appropriate diagram.
2. Select the **More Tools | WSDL** menu option from the Enterprise Architect UML Toolbox.
3. Drag the **Namespace** element from the Toolbox onto the diagram. The **WSDL Namespace Properties** dialog displays:

![WSDL Namespace Properties Dialog](image)

4. Type in a **WSDL Package Name** and **Target Namespace** name. You can edit these values later.
5. Click on the **OK** button to create a package stereotyped as **WSDLnamespace**. This contains the following sub-packages and an Overview diagram to navigate between the sub-packages:
   - **Types**: Contains the XSD types used by the WSDL Message elements; this package is modeled as an **XML Schema** and you drag **XSDElement**, **XSDsimpleType**, and **XSDcomplexType** elements onto the Types diagram from the XML Schema page of the Enterprise Architect UML Toolbox (see **Using Enterprise Architect - UML Modeling Tool**)
   - **Messages**: Contains the WSDL **Messages**, modeled as UML Classes marked with the stereotype **WSDLmessage**
   - **PortTypes**: Contains the WSDL **Port Types**, modeled as UML interfaces marked with the stereotype **WSDLportType**
   - **Bindings**: Contains the WSDL **Bindings**, modeled as UML Classes that realize the **PortTypes**
   - **Services**: Contains the WSDL **Services**, modeled as UML interfaces with associations to each exposed **Binding**.
6. Use the Overview diagram to navigate between the subpackages, by double-clicking the relevant packages. You can edit the sample WSDL elements created in the previous step, or drag new items from the **WSDL pages of the Toolbox** onto the relevant diagrams.

![Overview Diagram](image)

You can edit the WSDL-specific properties of the namespace later by double-clicking the package in the **Project Browser**. Alternatively, on the **WSDL Namespace Properties** dialog, click on the **UML** button to invoke the standard **Properties** dialog for a package. (This button does not display on the initial **WSDL Namespace Properties** dialog for a new Namespace element.)
2.2.1.2 WSDL Document

WSDL documents are represented in Enterprise Architect by UML components stereotyped as «WSDL». These components are modeled as direct child elements of the top-level WSDL namespace package. You can create multiple WSDL documents for a single namespace, thus enabling the services for that namespace to be reused and exposed as required across multiple WSDLs.

To define new WSDL document components for your namespace, follow the steps below:

1. Open the Overview diagram defined for your WSDL namespace package, and drag the WSDL element from the Toolbox onto the diagram. The WSDL Document Properties dialog displays.

![WSDL Document Properties dialog]

2. Type in the Name and File Name for the document.

3. The XMLNS panel lists the default XML namespaces used by the document. If required, click on the New button to add further namespaces.

   **Note:**

   You can also delete any namespace entries that you add. It is recommended that you do not delete any of the default entries, as it may cause an invalid WSDL document to be generated.

4. Select one or more services that should be exposed by this document. The list of available services is populated from the Services package.

5. Click on the OK button.

You can edit the WSDL-specific properties of the document later by double-clicking the component in the diagram or the Project Browser. Alternatively, click on the UML button in the WSDL Document Properties dialog to invoke the standard Properties dialog for a package. (This button does not display on the initial WSDL Document Properties dialog for a new WSDL element.)
2.2.1.3 WSDL Service

WSDL services are represented in Enterprise Architect by UML interfaces, stereotyped as WSDLservice. Services should be defined under the Services packages in the WSDL namespace structure.

To define new WSDLservice elements for your namespace, follow the steps below:

1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the Services package element to open the Services diagram.
2. Drag the Service element from the Toolbox onto the diagram. The WSDL Service dialog displays.

3. In the Name field, type the service name.
4. Click on the New button to add Service Ports. The WSDL Port dialog displays.

5. Type in the Port Name and Location, and select a Binding. The list of Bindings is taken from those defined in the Bindings package. For each Port defined in this way, Enterprise Architect creates an Association relationship between the Service and corresponding Binding element.
6. Click on the OK button to close the WSDL Port dialog. For each Port defined in this way, Enterprise Architect creates an Association relationship between the Service and corresponding Binding element.
7. Click on the OK button to close the WSDL Service dialog.

You can edit the WSDL-specific properties of the service later by double-clicking the Service interface in the diagram or Project Browser. Alternatively, click on the UML button in the WSDL Service dialog to invoke the standard Properties dialog for an interface. (This button does not display on the initial WSDL Service dialog for...
a new Service element.)

2.2.1.4 WSDL Port Type

WSDL Port Types are represented in Enterprise Architect by UML interfaces stereotyped as WSDLportType. PortTypes should be defined under the PortTypes packages in the WSDL namespace structure.

To define new WSDLportType elements for your namespace, follow the steps below:

1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the PortTypes package to open the PortTypes diagram.
2. Drag the Port Type element from the Toolbox onto the diagram. The WSDL PortType dialog displays.

![WSDL PortType dialog](image)

3. Type in the name for the portType.
4. Click on the OK button to close the WSDL PortType dialog.
5. Define operations for the portType by dragging the Port Type Operation item from the WSDL page of the Enterprise Architect UML Toolbox onto the portType interface. You can edit the WSDL-specific properties of the portType later by double-clicking the interface in the diagram or Project Browser. Alternatively, in the WSDL PortType dialog, click on the UML button to invoke the standard Properties dialog for an interface. (This button does not display on the initial WSDL PortType dialog for a new PortType element.)

2.2.1.5 WSDL Message

WSDL messages are represented in Enterprise Architect by UML Classes stereotyped as WSDLmessage. Messages should be defined under the Messages package in the WSDL namespace structure.

To define new WSDLmessage elements for your namespace, follow the steps below:

1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the Messages package to open the Messages diagram.
2. Drag the Message element from the Toolbox onto the diagram. The WSDL Message dialog displays.

![WSDL Message dialog](image)

3. Type in the Name for the message.
4. Click on the OK button to close the WSDL Message dialog.
5. You can define parts for the message by dragging the Message Part element from the WSDL
You can edit the WSDL-specific properties of the message later by double-clicking the Message element in the diagram or Project Browser. Alternatively, on the WSDL Message dialog, click on the UML button to invoke the standard Properties dialog for a Class. (This button does not display on the initial WSDL Message dialog for a new Message element.)

### 2.2.1.6 WSDL Binding

WSDL bindings are represented in Enterprise Architect by UML Classes stereotyped as `WSDLbinding`. Bindings should be defined under the Bindings package in the WSDL namespace structure. Each `WSDLbinding` Class implements the operations specified by a particular `WSDLportType` interface. Therefore, `WSDLportTypes should be defined before` creating `WSDLbindings`.

To define new `WSDLbinding` elements for your namespace, follow the steps below:

1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the Bindings package to open the Bindings diagram.
2. Drag the `Binding` element from the Toolbox onto the diagram. The WSDL Binding dialog displays.

3. Type in a **Name** for the Binding.
4. Select the **PortType** for the Binding; the drop-down list of PortTypes is taken from those defined in the PortTypes package.
5. Select the **Protocol** for the Binding, either `http` or `soap`.
6. For SOAP Bindings, enter the **Transport URL** and select the **Style**. For http Bindings, select the **Verb**.
7. Click on the **OK** button to close the WSDL Binding dialog and create the binding. A realization connector is created between the binding and the corresponding PortType interface.
8. To specify the Binding operations, select and double-click on an Operation in the Binding element. The WSDL Binding Operation Details dialog displays.
9. Type in or select the Binding Operation details.
10. Click on the **Parameters** button. The **WSDL Binding Operation Parameters** dialog displays. For each input, output and fault, click on the **Details** button and enter the details.
11. Click on the **OK** button on each of the **WSDL Binding Parameter Details**, **WSDL Binding Operation Parameters** and **WSDL Binding Operation Details** dialogs to close them.

You can edit the WSDL-specific properties of the binding later by double-clicking the binding Class in the diagram or **Project Browser**. Alternatively, on the **WSDL Binding** dialog, click on the **UML** button to invoke the standard **Properties** dialog for a Class. (This button does not display on the initial **WSDL Binding** dialog for a new Binding element.)

### 2.2.1.7 WSDL Port Type Operation

WSDL portType operations are represented in Enterprise Architect by operations defined as part of a WSDL portType interface (see the **WSDL Port Type** topic).

To add portType operations to your WSDL portType interfaces, follow the steps below.

1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the PortTypes package to open the PortTypes diagram.
2. Drag the **PortType Operation** item onto a WSDL portType stereotyped interface. The **WSDL PortType Operation** dialog displays.
3. Type in the Name for the operation.
4. Select the Operation Type.
5. Type in or select the Input, Output and Fault details for the operation. The Message drop-down list is taken from the WSDL message elements defined under the Messages package.
6. Click on the OK button to close the WSDL PortType Operation dialog and create the operation.

You can edit the WSDL-specific properties of the portType operation later by double-clicking the operation in the diagram or Project Browser. Alternatively, on the WSDL PortType Operation dialog, click on the UML button to invoke the standard Properties dialog for an operation. (This button does not display on the initial WSDL PortType Operation dialog for a new PortType Operation.)

### 2.2.1.8 WSDL Message Part

WSDL message parts are represented in Enterprise Architect by UML attributes defined as part of a WSDL message Class (see the WSDL Message topic).

To add message parts to your WSDL message Classes, follow the steps below:
1. Open the Overview diagram defined for your WSDL namespace package, and double-click on the Messages package to open the Messages diagram.
2. Drag the Message Part element onto a WSDL message stereotyped Class. The WSDL Message Part dialog displays.
3. Type in a **Name** and **Type** for the message part. The type should be selected from the drop-down list of primitive XSD types or from the types defined under the Types package.

4. Click on the **OK** button.

You can edit the WSDL-specific properties of the message part later by double-clicking the attribute in the diagram or Project Browser. Alternatively, on the WSDL Message Part dialog, click on the **UML** button to invoke the standard Properties dialog for an attribute. (This button does not display on the initial WSDL Message Part dialog for a new message part attribute.)

### 2.2.2 Generate WSDL

The **Generate WSDL** feature forward engineers a UML model to a Web Service Definition Language (WSDL) file. The Generate WSDL feature acts on a package stereotyped with `WSDLnamespace`. It is used to generate any or all of the WSDL stereotyped components owned by the target `WSDLnamespace` structure. To generate one or more WSDL files from a `WSDLnamespace`, follow the steps below:

1. In the **Project Browser**, right-click on the target `WSDLnamespace` package to display the context menu.
2. Select the **Code Engineering | Generate WSDL** menu option. The **Generate WSDL** dialog displays.
3. For each WSDL component, set the required output file using the Target File column.
4. Using the Encoding field, set the required XML encoding.
5. Click on the Generate button to generate the WSDL files.
6. The progress of the WSDL generator is shown in the Progress edit box.

Tip:
The Generate WSDL dialog can also be accessed from the active diagram by selecting the Project | Generate WSDL menu option.

### 2.2.3 Import WSDL

The WSDL Import facility is used to reverse engineer WSDL files as UML Class models. To import a WSDL file, follow the steps below:

1. In the Project Browser, right-click on the package to contain the imported WSDL package. The context menu displays.
2. Select the Code Engineering | Import WSDL menu option. The Import WSDL dialog displays.
3. In the **Filename** field, select the input file.
4. The **Target Package** field is automatically set to the name of the selected input file. If required, change this name.
5. Click on the **Import** button to import the schema.
6. The progress of the WSDL import is shown in the **Progress** status bar.
You perform database modeling and database design in Enterprise Architect using the UML Data Modeling Profile. This profile provides easy-to-use and easy-to-understand extensions to the UML standard, mapping the database concepts of tables and relationships onto the UML concepts of Classes and associations. These extensions also enable you to model database keys, triggers, constraints, RI and other relational database features.

**Note:**
The UML Data Modeling Profile is not currently a ratified standard; however it has wide industry support and is a useful method for bridging the gap between the UML and conventional relational database modeling.

Typical data modeling tasks you might perform are listed at the end of this topic.

### Tables and Columns

The basic modeling structure of a relational database is the **table**, which represents a set of records, or rows, with the same structure. The basic organizational element of a relational database is the **column**. Every individual item of data entered into a relational database is represented by a value in a column of a row in a table.

The UML Data Modeling Profile represents:
- Tables as stereotyped **Classes**; that is, Class elements with a **stereotype** of **table**
- Columns as stereotyped **attributes**; that is, attributes with a **stereotype** of **column**.

Enterprise Architect can generate simple DDL scripts to create the tables in your model. You can also perform Model Driven Architecture (MDA) Transformations to DDL - Enterprise Architect provides a template specifically for DDL transformations (see the MDA Transformations User Guide).

To help you map Class attributes to Table fields, you can create connectors between specific attributes in the Class element and the column attributes in the Table element. See the Connect to Element Feature topic in UML Modeling With Enterprise Architect - UML Modeling Tool.

### Database Keys

Two types of key are used to access tables: **Primary Keys** and **Foreign Keys**. A Primary Key uniquely identifies a record in a table, while a Foreign Key accesses data in some other related table via its Primary Key.

A Primary Key consists of one or more columns; a simple Primary Key (single column) is defined as the attribute of a stereotyped operation. A complex Primary Key (several columns) is defined as the stereotyped operation itself.

A Foreign Key is a collection of columns (attributes) that together have some operational meaning (they enforce a relationship to a Primary Key in another table). Foreign keys are represented in Enterprise Architect as operations with the stereotype **FK**; the operation parameters become the columns involved in the key.

### Supported Databases

Enterprise Architect supports import of database schema from these databases:

- DB2
- Firebird/InterBase
- Informix
- Ingres
- MS Access 97, 2000, 2003
- Access 2007
- MS SQL Server
- MySQL
- Oracle 9i, 10g and 11g
- PostgreSQL
- Sybase Adaptive Server Anywhere (Sybase ASA)
- Sybase Adaptive Server Enterprise (Sybase ASE).

**Note:**

Firebird 1.5 database tables can be modeled and generated as InterBase tables. Firebird tables can be imported but are treated as InterBase tables.

**Typical Tasks**

Typical tasks you can perform when modeling or designing databases include:

- Create a Data Model Diagram
- Create a Table
- Set Properties of a Table
- Create Columns
- Create Oracle Packages
- Create Primary Keys
- Create Foreign Keys
- Create Stored Procedures
- Create Views
- Create Indexes, Check Constraints and Triggers
- Generate DDL for a Table
- Generate DDL for a Package, and compare with the database
- Convert Datatypes for a Table
- Convert Datatypes for a Package
- Customize Datatypes for a DBMS
- Import a Database Schema from an ODBC Data Source
3.1 A Data Model Diagram

An example of a Data Model diagram is provided below, showing three tables that are linked on primary to foreign key pairs with associated multiplicity.

Note the use of stereotyped operations for Primary (PK) and Foreign (FK) keys. Operations could also be added for:

- Triggers
- Constraints (check, unique)
- Indexes

A Data Model diagram is represented in Enterprise Architect as a Class diagram, and is created in exactly the same way as other diagrams (see the Working With Diagrams topic in UML Modeling With Enterprise Architect - UML Modeling Tool).
3.2 Create a Table

What is a Table?
The basic modeling structure of a relational database is the Table. A Table represents a set of records, or rows, with the same structure.

The UML Data Modeling Profile represents a Table as a stereotyped Class; that is, a Class element with a stereotype of `table` applied to it. A table icon is shown in the upper right corner of the image when it is shown on a Data Model diagram.

Create a Table
To create a Table, follow the steps below:
1. Select a diagram.
3. Click on the Table element in the list of elements, then click on the diagram. The Table element is displayed on the diagram.

4. If the Class: Table n Properties dialog does not display, double-click on the Table to display it.
5. In the Name field, type a name for the Table and set any other properties as required.
6. Click on the OK button.
3.3 Set Table Properties

Once you have created your table, you can set its properties. Most table properties can be set from the Properties dialog, as described below. However, some properties must be entered as Tagged Values as described for setting the value of the Table Owner and, for MySQL and Oracle databases, setting the table options.

Set the Database Type

The most important property to set for a table (after its name) is the database type. This defines the list of datatypes that are available for defining columns, and also declares which dialect of DDL is generated.

Enterprise Architect supports the following databases:

- DB2
- Informix
- Ingres
- InterBase
- MS Access 97, 2003, 2003
- Access 2007
- MySQL
- Oracle 9i, 10g and 11g
- PostgreSQL
- SQL Server 2000, 2005 and 2008
- SQL Server 7
- Sybase Adaptive Server Anywhere (Sybase ASA)
- Sybase Adaptive Server Enterprise (Sybase ASE).

To set the database type, follow the steps below:

1. Double-click on the table element in a diagram to open the Properties dialog.
2. Select the General tab.
3. In the **Database** field, click on the drop-down arrow and select the database type.

4. Click on the **Apply** button to save changes.

By clicking on the **Table Detail** tab on this dialog, you can access the **Columns dialog** or **Operations dialog** or you can **Generate DDL** for this table.
3.3.1 Set Table Owner

To define the owner of a table, follow the steps below:

1. Select the View | Tagged Values menu option or press [Ctrl]+[Shift]+[6]. The Tagged Values window displays.
2. Click on the table in a diagram or the Project Browser. The Tagged Values window now shows the tags for the selected table.
3. Click on the New Tag button. The Tagged Value dialog displays.
4. In the Tag field, type the tag name Owner. In the Value field, type a value for the Owner tag.

**Note:**

For a PostgreSQL database, to define the owner name:

- In the Tag field, type the tag name OWNER TO
- In the Value field, type Owner_Name.

5. Click on the OK button to confirm the operation. Generated DDL includes the table owner in the SQL script.
3.3.2 Set MySQL Options

In MySQL, to make use of foreign keys you must declare the table type as **InnoDB**. To do this, follow the steps below:

1. Select the **View | Tagged Values** menu option or press **[Ctrl]+[Shift]+[6]**. The Tagged Values window displays.
2. Click on the table in a diagram or in the **Project Browser**. The Tagged Values window shows the table as selected.
3. Click on the **New Tag** button. The Tagged Value dialog displays.
4. In the **Tag** field, enter the tag name **Type**. In the **Value** field, type **InnoDB** as the value for the **Type** tag.
5. Click on the **OK** button to confirm the operation. Generated DDL includes the table type in the SQL script.
6. To allow for later versions of MySQL, additional table options that can be added in the same manner include:

<table>
<thead>
<tr>
<th>Tag</th>
<th>Value (Example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGINE</td>
<td>InnoDB</td>
</tr>
<tr>
<td>CHARACTER SET</td>
<td>latin1</td>
</tr>
<tr>
<td>CHARSET</td>
<td>latin1</td>
</tr>
<tr>
<td>COLLATE</td>
<td>latin1_german2_ci</td>
</tr>
</tbody>
</table>

3.3.3 Set Oracle Table Properties

For Oracle, you can set table properties using the table’s Tagged Values. Follow the steps below:

1. Select the **View | Tagged Values** menu option, or press **[Ctrl]+[Shift]+[6]**. The Tagged Values window displays.
2. Click on the table in a diagram or in the **Project Browser**. The Tagged Values window displays the table name, selected.
3. Click on the **(New Tag)** button.
4. Define the table properties as shown in the examples below:
Click on the **OK** button to save the Tagged Value. All available properties for an Oracle table are listed below.

**Note:**
The same properties can be added to index and constraints. Highlight the index or constraint and add the properties as Tagged Values.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUFFER_POOL</td>
<td>DEFAULT</td>
</tr>
<tr>
<td>CACHE</td>
<td>NOCACHE</td>
</tr>
<tr>
<td>DBVERSION</td>
<td>9.0.111</td>
</tr>
<tr>
<td>FREELISTS</td>
<td>1</td>
</tr>
<tr>
<td>GRANT OWNER1</td>
<td>SELECT</td>
</tr>
<tr>
<td>GRANT OWNER2</td>
<td>DELETE, INSERT, SELECT, UPDATE</td>
</tr>
<tr>
<td>INITIAL</td>
<td>65536</td>
</tr>
<tr>
<td>INITRANS</td>
<td>1</td>
</tr>
<tr>
<td>LOGGING</td>
<td>LOGGING</td>
</tr>
<tr>
<td>MAXEXTENTS</td>
<td>2147483645</td>
</tr>
<tr>
<td>MAXTRANS</td>
<td>255</td>
</tr>
<tr>
<td>MINEXTENTS</td>
<td>1</td>
</tr>
<tr>
<td>MONITORING</td>
<td>MONITORING</td>
</tr>
<tr>
<td>OWNER</td>
<td>OWNER1</td>
</tr>
<tr>
<td>PARALLEL</td>
<td>NOPARALLEL</td>
</tr>
<tr>
<td>PCTFREE</td>
<td>10</td>
</tr>
</tbody>
</table>
The properties defined for a given table are listed on the Tagged Values window, as illustrated by the following typical Tagged Value list:

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCTINCREASE</td>
<td>0</td>
</tr>
<tr>
<td>PCTUSED</td>
<td>0</td>
</tr>
<tr>
<td>SYNONYMS</td>
<td>PUBLIC:TABLE_PUB;OWNER2:TABLE_OWNER2</td>
</tr>
<tr>
<td>TABLESPACE</td>
<td>MY_TABLESPACE</td>
</tr>
<tr>
<td>TEMPORARY</td>
<td>YES</td>
</tr>
</tbody>
</table>

```sql
BUFFER_POOL   DEFAULT
CACHE         NOCACHE
COMPRESSION   DISABLED
DBVERSION     10.2.10
INITIAL       65536
INTRANS       1
LOGGING       LOGGING
MAXEXTENTS    2147483645
MAXTRANS      255
MINTENTS      1
MONITORING    MONITORING
OWNER         PLSQL
PARALLEL      NOPARALLEL
PCTFREE       10
PCTINCREASE   0
PCTUSED       0
TABLESPACE    USERS
```
3.4 *Create Columns*

**What is a Column?**

The basic organizational element of a relational database is the *column*. Every individual item of data entered into a relational database is represented as a value in a column of a row in a table. Columns are represented in the UML Data Modeling Profile as a stereotyped attribute; that is, an attribute with the *Column* stereotype.

**Create Columns**

*Note:* For MySQL, before creating columns first add ENUM and SET datatypes. Select the *Settings | Database Datatypes* menu option and, on the *Database Datatypes* dialog, in the *Product Name* field select *MySQL*. Add the datatypes ENUM and SET.

To create columns, follow the steps below:

1. Right-click on the Table in a diagram to open the context menu, and select the *Attributes* menu option.
2. The `<Tablename>` *Columns* dialog displays.

3. In the *Name* field, type the column name.
4. In the *Data Type* field, click on the drop-down arrow and select the data type, and click on the *Save* button.
Tip:
If the drop-down list of datatypes is empty, this means that you have not selected a target database for the table. Close the Columns dialog and re-open the Table Properties dialog to set a database type before continuing. To prevent this recurring, set the default database type

5. The following fields for each column are optional:
   - **Primary Key** - select the checkbox if the column represents the primary key for this table
   - **Not Null** - select the checkbox if empty values are forbidden for this column
   - **Unique** - select the checkbox if it is forbidden for any two values of this column to be identical
   - **Initial** - type a value that can be used as a default value for this column, if required
   - **Access** - click on the drop-down arrow and select a scope of Private, Protected or Public (the field defaults to Public)
   - **Alias** - type an alternative name for the field (for display purposes), if any
   - **Notes** - type any other information necessary to document the column; you can format the text using the Rich Text Notes toolbar at the top of the field.

Notes:
- The **unique** characteristic applied to a single column ensures that no two data values in the column can be identical. The **unique** stereotype applied to an index ensures that no two combinations of values across a set of columns can be identical.
- Some datatypes, such as the Oracle NUMBER type, require a precision and scale. These fields are displayed where required and should be filled in as appropriate. For example, for Oracle:

```
create NUMBER by setting Precision = 0 and Scale = 0
create NUMBER(8) by setting Precision = 8 and Scale = 0
create NUMBER(8,2) by setting Precision = 8 and Scale = 2.
```
- Oracle VARCHAR2(15 CHAR) and VARCHAR2(50 BYTE) datatypes can be created by adding the tag **LengthType** with the value **CHAR** or **BYTE**.
- For MySQL ENUM and SET datatypes, in the **Initial** field type the values as a comma-separated list, in the format (**'one','two','three'**) or, if one value is the default, in the format: (**'one','two','three'**) **default 'three'**.

5. Click on the **Column Properties** button. The **Database Columns Properties** dialog displays.

If you require a sequence, such as an Oracle sequence, select the **AutoNum** property, set the value to True and, if necessary, define the start number and increment. Click on the **OK** button to return to the `<Tablename> Columns` dialog.
6. Click on the **Save** button and on either the **New** button to define another column or the **Close** button to exit from the dialog.

**Change the Column Order**

To change the column order, follow the steps below:

1. On the **Columns** dialog, highlight a column name in the **Columns** panel.
2. Click on the:
   - **button to move the column up one position**
   - **button to move the column down one position**.
3.5 Create Oracle Packages

To create an Oracle package, follow the steps below:

1. Open the project in the Project Browser and create an Enterprise Architect package (and, if required, a Class diagram).
2. Add a Class element to either the package or the diagram.
3. Open the Properties dialog for the element and, in the Stereotype field, type the value Package.
4. For the package specification, create an Operation with the name Specification and with no return type.
5. Open the Properties dialog for the Specification Operation and, on the Behavior tab, type the entire package specification into the Initial Code field.
6. For the package body, create an Operation with the name Body and with no return type.
7. Open the Properties dialog for the Body Operation and, on the Behavior tab, type the entire package body into the Initial Code field.

For information on working with Operations, see UML Modeling With Enterprise Architect - UML Modeling Tool.
3.6 Primary Key

What is a Primary Key?
Keys are used to access tables, and come in two varieties: Primary Keys and Foreign Keys. A Primary Key uniquely identifies a record in a table, while a Foreign Key accesses data in some other related table via its Primary Key.

Define a Simple Primary Key
If a Primary Key consists of a single column, it is very easy to define.
1. Right-click on the table in a diagram to display the context menu. Select the Attributes menu option.
2. In the Attributes dialog, select the column that makes up the Primary Key.
3. Select the Primary Key checkbox and click on the Save button. A stereotyped operation is automatically created. It is this operation that defines the Primary Key for the table. To remove a Primary Key, simply delete this operation.

Define a Complex Primary Key
Often, a Primary Key consists of more than one column. For example, a column LastName might not be unique within a table, so a Primary Key is created from the LastName, FirstName and DateOfBirth columns. Perform the following steps to create a complex Primary Key:
1. Follow the steps above to create a Simple Primary Key. It doesn't matter which column you choose.
2. Right-click on the table in a diagram to open the context menu. Select the Operations menu option.
3. Select the Primary Key operation (its name begins with PK_) and then click on the Column tab.
4. To add a column to the Primary Key, click on the New button, select a column from the Column Name list box, and then click on the Save button.
5. Click on the Hand buttons (up and down arrow) to change the order of columns in the Primary Key, if necessary. (See also the SQL Server Non-Clustered Primary Keys topic).

Define a Primary Key Name Template
To define the name template for a Primary Key, follow the steps below:
2. Click on the **DDL Name Templates** button. The **DDL Name Template** dialog displays, showing the default name templates.

![DDL Name Template Dialog](image)

3. Edit or replace the template in the **Primary Key Name Template** field.

   **Note:**

   If you want to display the Primary Key description as `PK_tablename_columnname` then change the **Primary Key Name Template** field to `PK_%tablename%_%columnname%`.

4. Click on the **Save** button.

### 3.6.1 SQL Server Non Clustered Keys

To define a primary key as non-clustered for a SQL Server table, follow the steps below:

1. Right-click on the table in a diagram to open the context menu.
2. Select the **Operations** menu option. The Table **Operations** dialog displays.
3. Highlight the Primary Key Operation and select **Extended Properties**. The Database Operation
Properties dialog displays.

4. Select the **SQL Server Non Clustered Primary Key** checkbox.
5. Click on the **Save & Close** button.
3.7 Foreign Key

What is a Foreign Key?

Two types of key are used to access tables: Primary Keys and Foreign Keys. A Primary Key uniquely identifies a record in a table, while a Foreign Key accesses data in some other related table via its Primary Key.

Foreign keys are represented in Enterprise Architect UML using stereotyped operations. A Foreign Key is a collection of columns (attributes) that together have some operational meaning (they enforce a relationship to a Primary Key in another table). A Foreign Key is modeled as an operation stereotyped with the FK stereotype; the operation parameters become the columns involved in the key.

Note:

It isn't necessary to define a Foreign Key in order to access another table through its Primary Key. Foreign Keys are a feature of some database management systems, providing 'extras' such as referential integrity checking that prevents the deletion of a record if its Primary Key value exists in some other table's Foreign Key. The same thing can be achieved programmatically.

To create a Foreign Key, click on the link.

You might also have to define a Name Template for Foreign Keys.

3.7.1 Create Foreign Key

To create a Foreign Key, follow the steps below:

1. Locate the required Tables in a diagram.
2. Select an Associate connector in the Class Relationships page of the Enterprise Architect UML Toolbox.
3. Click on the Table to contain the Foreign Key (source) and draw the connector to the other Table (target).
4. Right-click on the connector to display the context menu, and select the Foreign Keys option. The Foreign Key Constraint dialog displays.
5. If necessary, edit the default name for the Foreign Key.
6. Highlight the columns involved in the Foreign Key relationship.
7. Click on the **Save** button to automatically generate the Foreign Key operations.

You have created the Foreign Key. The example below shows how this looks in a diagram:
Composite Foreign Key

To create a composite Foreign Key, select the appropriate columns and click on the **Save** button. The Foreign Key columns are sorted according to datatype to match the datatypes of the targeted composite Primary Key.

If required, you can change the order of the key columns by clicking on the and buttons.

**Tip:**
If you are defining a MySQL database and want to use Foreign Keys, you must set the table type to enable this.
This creates the composite Foreign Key. The example below shows how this looks in a diagram:
3.7.2 Define Foreign Key Name Template

To define the name template for a Foreign Key, follow the steps below:

2. Click on the **DDL Name Template** button. The **DDL Name Template** dialog displays, showing the default name templates.

![DDL Name Template dialog](image)

3. Edit or replace the name template in the **Foreign Key Name Template** field.

   **Note:**
   
   If you want to display the Foreign Key description as `FK_foreigntablename_FKcolumnname_primarytablename_PKcolumnname` then change the **Foreign Key Name Template** field to `FK_%foreigntablename%_%fkcolumnname%_%primarytablename%_%pkcolumnname%`.

4. Click on the **Save** button.
3.8 Stored Procedures

What is a Stored Procedure?
A stored procedure is a group of SQL statements that form a logical unit and perform a particular task. Stored procedures are used to encapsulate a set of operations or queries to execute on a database server. You can compile and execute stored procedures with different parameters and results, and they can have any combination of input, output and input/output parameters.

Enterprise Architect models stored procedures as individual Classes.

Note:
Stored procedures are currently supported for: DB2; SQL Server; Firebird/Interbase; Informix; Ingres; Oracle 9i, 10g and 11g; MySQL; PostgreSQL; Sybase Adaptive Server Enterprise (ASE) and Sybase Adaptive Server Anywhere (ASA).

3.8.1 Create Individual Class Procedure
To create a stored procedure as an individual Class, follow the steps below:

1. Open the required diagram.
2. From the Data Modeling page of the Enterprise Architect UML Toolbox (More tools | Data Modeling) drag the Procedure icon onto the diagram.
3. If the Properties dialog does not automatically display, double-click on the element.
4. In the **Database** field click on the drop-down arrow and select the target DBMS to model. (The field displays the default database if it has already been set.)

5. In the **Procedure definition** field, type the entire procedure text.

6. Click on the **OK** button.

To define a name for the stored procedure, click on the element, click on the name (**Class<n>**) and click again. This highlights the text for editing. Type in the required name. (For further details, see the *In-Place Editing* section in *UML Modeling With Enterprise Architect - UML Modeling Tool.*)
3.9 Views

Note:
Views are currently supported for: DB2; SQL Server; Firebird/Interbase; Informix; Ingres; Oracle 9i, 10g and 11g; MySQL; PostgreSQL; Sybase Adaptive Server Enterprise (ASE) and Sybase Adaptive Server Anywhere (ASA).

Create a View
To create a database View, follow the steps below:

2. If the View Properties dialog does not immediately display, double-click on the element.
3. From the Database drop-down list, select the target DBMS to model. The default database displays if it has already been set.
4. Click on the OK button.

To define a name for the View, click on the element, click on the name (Class<n>) and click again. This highlights the text for editing. Type in the required name. (For further details, see the In-Place Editing section in UML Modeling With Enterprise Architect - UML Modeling Tool.)

Define View Properties

1. Create a Dependency connector from the View to the table or tables on which the View depends.
2. Double-click on the View to display the Properties dialog. The tables are now listed in the Dependencies field.
3. In the View definition field, type the full view definition. (The code editor provides Intellisense for basic SQL keywords and functions - see Using Enterprise Architect - UML Modeling Tool).
4. Click on the OK button to save your definition. An example diagram is shown below:
3.10 Index, Trigger, Check Constraint

What is an Index?
An index is a sorted look-up for a table. When it is known in advance that a table must be sorted in a specific order, it is usually worth the small processing overhead to always maintain a sorted look-up list rather than sort the table every time it is required. In Enterprise Architect, an index is modeled as a stereotyped operation. On generating DDL, the necessary instructions for generating indexes are written to the DDL output.

The unique characteristic applied to a single column ensures that no two data values in the column can be identical. The unique stereotype applied to an index ensures that no two combinations of values across a set of columns can be identical.

What is a Trigger?
A trigger is an operation automatically executed as a result of the modification of data in the database, and usually ensures consistent behavior of the database. For example, a trigger might be used to define validations that must be performed every time a value is modified, or might perform deletions in a secondary table when a record in the primary table is deleted. In Enterprise Architect, a trigger is modeled as a stereotyped operation. Currently Enterprise Architect does not generate DDL for triggers, but nonetheless they aid in describing and specifying the table structure in detail.

What is a Check Constraint?
A Check Constraint enforces domain integrity by limiting the values that are accepted by a column.

Create an Index
Ensure that the column(s) to be used in the index have already been defined in the table.

1. Right-click on the required table either in a diagram or in the Project Browser.
2. Select the Operations context menu option. The Operations dialog displays.
3. Add an operation (with a name such as IDX_CustomerID; the IDX_ prefix is optional but it helps identify the operation).
4. In the Stereotype field for the operation, select index (check and unique are also supported).
5. Click on the Column tab.
6. Select the required columns from the Columns drop-down list in the required order, then click on the Save button to save changes.

Create a Check Constraint or Trigger
1. Locate the required table in either a diagram or the Project Browser.
2. Use the context menu to open the Operations dialog.
3. Add an operation (such as CHK_ColumnName or TRG_OnCustomerUpdate; the CHK_ and TRG_ prefixes are optional but help identify the operation).
4. In the Stereotype field for the constraint, select check or trigger as appropriate and click on the Save button to save changes.
5. Select the constraint operation, then the Behavior tab.
6. Enter the entire check constraint clause (for example, col1 < 1000), or the entire trigger code (including the CREATE TRIGGER statement) in the Initial Code field and click on the Save button to save changes.

The example below shows how an index looks in a diagram (in the Order element):
### 3.11 Generate DDL For a Table

#### Note:

In the Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect, if security is enabled you must have Generate Source Code and DDL permission to generate DDL. See User Security in UML Models.

To generate simple DDL scripts to create the tables in your model, follow the steps below:

1. In the diagram, right-click on the table for which to generate DDL. The context menu displays.
2. Select the **Generate DDL** option. The Generate DDL dialog displays.

3. In the **Path** field, use the `[ ... ] (Browse)` button to select the filename of the script to create.

4. To include comments in the DDL, in the **Comment Level** field select the appropriate level. For example, **Column** for comments on columns, or **All** for comments on all structures.

5. Select the checkboxes for the appropriate inclusions. For example, to include a 'drop table' command in the script, select the **Create Drop SQL** checkbox. Deselect the checkboxes for inclusions you do not require.
Notes:

- Some checkboxes display only if the appropriate database is defined for the table. For example, `IF EXISTS` displays only if the database for the table is PostgreSQL.

- If generating Oracle sequences, you must always select the Generate Triggers and Generate Sequences checkboxes; this ensures that a pre-insert trigger is generated to select the next sequence value to populate the column. Also select the Auto Numbering checkbox in the column properties.

6. To create the DDL, click on the Generate button.

7. To view the output, click on the View button (you must configure a DDL viewer in the Local Settings dialog first).

Note:

You can transport these DDL scripts between models, using the Export Reference Data and Import Reference Data options on the Tools menu. See the Reference Data topic in UML Model Management.
3.12 Generate DDL for a Package

**Note:**

In the Corporate, Business and Software Engineering, System Engineering and Ultimate editions of Enterprise Architect, if security is enabled you must have **Generate Source Code and DDL** permission to generate DDL. See *User Security in UML Models*.

In this procedure, you can generate DDL for a package, and also compare the DDL with the database.

**Generate DDL**

To generate DDL for a package, follow the steps below:

1. Right-click on the required package in the **Project Browser**. The context menu displays.
2. Select the **Code Engineering** | **Generate DDL** menu option. The **Generate Package DDL** dialog displays.
Generate DDL for a Package

Options
- Root Package: DDL
- Options:
  - Comment Level
  - Use ;
  - Generate Triggers
  - Generate Stored Procedures
  - Generate Views
  - Generate Drop SQL
  - Use as SQL Terminator
  - Use and around names
  - Generate Table Owner
  - Use Database
  - Use Alias if Available
  - Use NULL for nullable columns
- File Generation:
  - Single File
  - Individual file for each table
- Select Objects to Generate
  - Account: table
  - LineItem: table
  - Order: table
  - OrderStatus: table
  - ShoppingBasket: table
  - StockItem: table
  - Transaction: table

Note:
Alternatively you can select the Project | Database Engineering | Generate Package DDL menu option.

3. Select the checkbox against each inclusion required. Deselect the checkboxes for inclusions you do not require.
Notes:

- Some checkboxes display only if the appropriate database is defined for the tables in the package. For example, `IF EXISTS` displays only if the database for the tables is PostgreSQL.

- If generating Oracle sequences, you must always select the Generate Triggers and Generate Sequences checkboxes; this ensures that a pre-insert trigger is generated to select the next sequence value to populate the column. Also select the Auto Numbering checkbox in the column properties.

4. To recursively generate DDL, select the Include All Child Packages checkbox.

5. Click on the Generate button to proceed. Enterprise Architect prompts you for file names as the process executes.

**Compare DDL For a Database**

When you have generated the DDL, you can compare it with the database. To do this, follow the steps below:

1. On the Generate Package DDL dialog, click on the Compare button. The Compare With Database dialog displays.

2. Click on the `[ ... ]` button and locate the required database on the Select Data Source dialog.

3. For an Oracle database, if required you can also specify the Owner in the Schema/Owner field.

4. Click on the View button to perform the comparison. The Comparison Database dialog displays with the results of the comparison.
Generate DDL for a Package |
3.13 **Data Type Conversion Procedure**

Once a database schema has been set up on an Enterprise Architect diagram (either by importing through ODBC or manually setting up the tables), the DBMS can be changed to another type and the column datatypes are mapped accordingly.

To map the DBMS type of a table to another DBMS type, follow the steps below:

1. Double-click on the table element in a diagram to open the table Properties dialog.
2. The **Database** field shows the current DBMS for this table.
3. To map the column datatypes to another DBMS, select the target from the **Database** drop-down and click on the **Apply** button.
4. The datatypes are converted to match those of the new DBMS, and these are reflected in any DDL generated from this table.
3.14 Data Type Conversion for a Package

The DBMS Package procedure or mapper enables you to convert a package of database tables from one DBMS type to another DBMS type, as well as providing the ability to change the ownership of tables.

To map the DBMS types of a package to another DBMS type, follow the steps below:

1. Right-click on the package in the Project Browser to display the context menu.
2. Select the Code Engineering | Reset DBMS Options menu option. The Manage DBMS Options dialog displays.

3. In the Current DBMS field, click on the drop-down arrow and select the current DBMS. In the New DBMS field click on the drop-down arrow and select the target DBMS.
4. Select the Convert DBMS Type checkbox.
5. If there are child packages that also require changing, select the Process Child Packages checkbox.
6. Click on the OK button. All tables in the selected packages are mapped to the new DBMS.

To change the owner of the table or all of the tables in a package, follow the steps below:

1. Right-click on the package in the Project Browser to display the context menu.
2. Select the Code Engineering | Reset DBMS Options menu option. The Manage DBMS Options dialog displays.
3. In the **New Owner** field, type the name for the new table owner.

4. In the **Current Owner** field, click on the drop-down arrow and select the current owner to change, or select `<All>` to change the ownership of all tables in the package to the name you typed in the **New Owner** field.

5. Select the **Change Table Owner** checkbox.

6. If there are child packages that also require changing, select the **Process Child Packages** checkbox.

7. Click on the **OK** button. The ownership changes for all Tables in the selected packages with the specified current owner.

For more information on setting the table owner see the [Set Table Owner](#) topic. To display the table owner in the current diagram see the [Diagram Properties](#) topic in [UML Modeling with Enterprise Architect – UML Modeling Tool](#).
3.15 DBMS Datatypes

When setting up your data modeling profile, you can customize the datatypes associated with a particular DBMS using the Database Datatypes screen. This screen enables you to add and configure custom data types. For some data types you must add the size and precision, defaults and maximum values.

To access the Database Datatypes screen, select the Settings | Database Datatypes menu option. You can also add a DBMS product and configure the inbuilt data types.

![Database Datatypes Screen](image)

You can also map database datatype sizes between products. To do this, follow the steps below:

2. In the **From Product Name** field, click on the drop-down arrow and select the DBMS product to map datatypes *from*. The **Defined Datatypes for Databases** panel displays all the defined datatypes for the product and, where appropriate, their sizes and values.

3. Click on the datatype to map (this must have a defined size unit and value). The **Datatype** and **Common type** fields under the **From Product Name** field display this datatype.

4. In the **To Product Name** field, click on the drop-down arrow and select the DBMS product to map datatypes *to*. The **Datatype** and **Common Type** fields under this field display the corresponding values to those in the fields for the *from* product.

5. In the **Size** panel, click on the radio button for the appropriate size unit and type the default values in the corresponding data fields.

6. Click on the **Save** button to save the mapping.

7. To map further datatypes, repeat this process from step 3.

8. When you have finished mapping datatypes, click on the **Close** button, and again on the **Database Datatypes** dialog.
Analysis of legacy database systems is possible using Enterprise Architect’s reverse engineering capabilities. By connecting to a live database via ODBC, you can import the database schema into a standard UML model. Subsequent imports enable you to maintain synchronization between the data model and the live database.

Enterprise Architect supports importing database tables from an ODBC data source. Tables are imported as stereotyped Classes with suitable data definitions for the source DBMS.

**Note:**

Import of stored procedures and views is supported for: DB2; SQL Server; Firebird/Interbase; Informix; Ingres; Oracle 9i, 10g and 11g; MySQL; PostgreSQL; Sybase Adaptive Server Enterprise (ASE) and Sybase Adaptive Server Anywhere (ASA).

### Import Database Tables and Stored Procedures

To import database tables and stored procedures, follow the steps below:

1. Select any package in the Logical View.
2. To import into:
   - The package only, right-click on the package to display the context menu, and select the **Code Engineering | Import DB Schema from ODBC** menu option.
   - A diagram, right-click on the diagram in the selected package to open the context menu, and select the **Import DB schema from ODBC** menu option.

**Note:**

Alternatively you can select the **Project | Database Engineering | Import DB Schema from ODBC** menu option.

The **Import DB Schema from ODBC Source** dialog displays.
3. In the **Database Name** field, click on the [ ... ] (Browse) button and select a suitable ODBC data source from the ODBC dialog (ODBC must be installed and configured on your machine for this to work correctly).

4. If importing from Oracle, to restrict the import to a specific owner, type the owner name in the **Schema/Owner** field.

   For imports from other types of database, leave this field blank.

5. In the **Filter** panel, select the appropriate checkboxes for additional items to include in the import.

   If you select to import **User Stored Procedures**, **User Functions** and/or **User Sequences** as individual Classes, then they are imported as separate elements and the **Properties** dialog is solely concerned with the Stored Procedure, Function or Sequence definition.

   If you select to import them as Class operations, then they are imported as operations (methods) and you view and edit them through the **Operations Properties** dialog of the parent Class.

6. When synchronizing existing Classes, select the appropriate checkbox in the **Synchronization** panel to determine whether the model comments, default values or constraints are to be synchronized with the ODBC tables.

7. Select the appropriate checkboxes to import user views, triggers, stored procedures, Oracle packages or system tables and views.
8. Click on the **Import** button to start the import.
9. **Select the tables** and - if appropriate - stored procedures to import.

This completes the procedure. See the **Imported Class Elements** topic.

### 3.16.1 Select a Data Source

To import DDL from existing data sources, you must have a suitable ODBC connection installed and configured. From the **Import DB Schema from ODBC Source** dialog you can select the ODBC data source using the standard windows **ODBC set-up** dialog. Click on the data source name and then click on the **OK** button.
3.16.2 Select Tables

When you have opened the ODBC data source, Enterprise Architect acquires a list of tables and stored procedures suitable for importing. This is presented in a list form for you to select from.

Highlight the tables and stored procedures to import and clear those you do not require.

Selection shortcuts:
- To select all tables and procedures, click on the **Select All** button
- To clear all tables and procedures, click on the **Select None** button
- Hold down [Ctrl] while clicking on tables and procedures to select multiple objects
- Hold down [Shift] and click on tables and procedures to select a range.

When you have selected the tables and procedures, click on the **OK** button.

3.16.3 The Imported Class Elements

When you import DDL table definitions they are converted to stereotyped Classes according the **UML Data Modeling Profile**.

If any stored procedures are imported, a Class stereotyped as a «stored procedures» container is created having the same name as the database being imported. The stored procedures are represented as operations in this Class.

The image below shows some example tables imported into the model using an ODBC data connection.
Import Database Schema from ODBC | The Imported Class Elements

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