

Creating a new Modeling Language: Metamodelling with ADOxx – An Example

Knut Hinkelmann

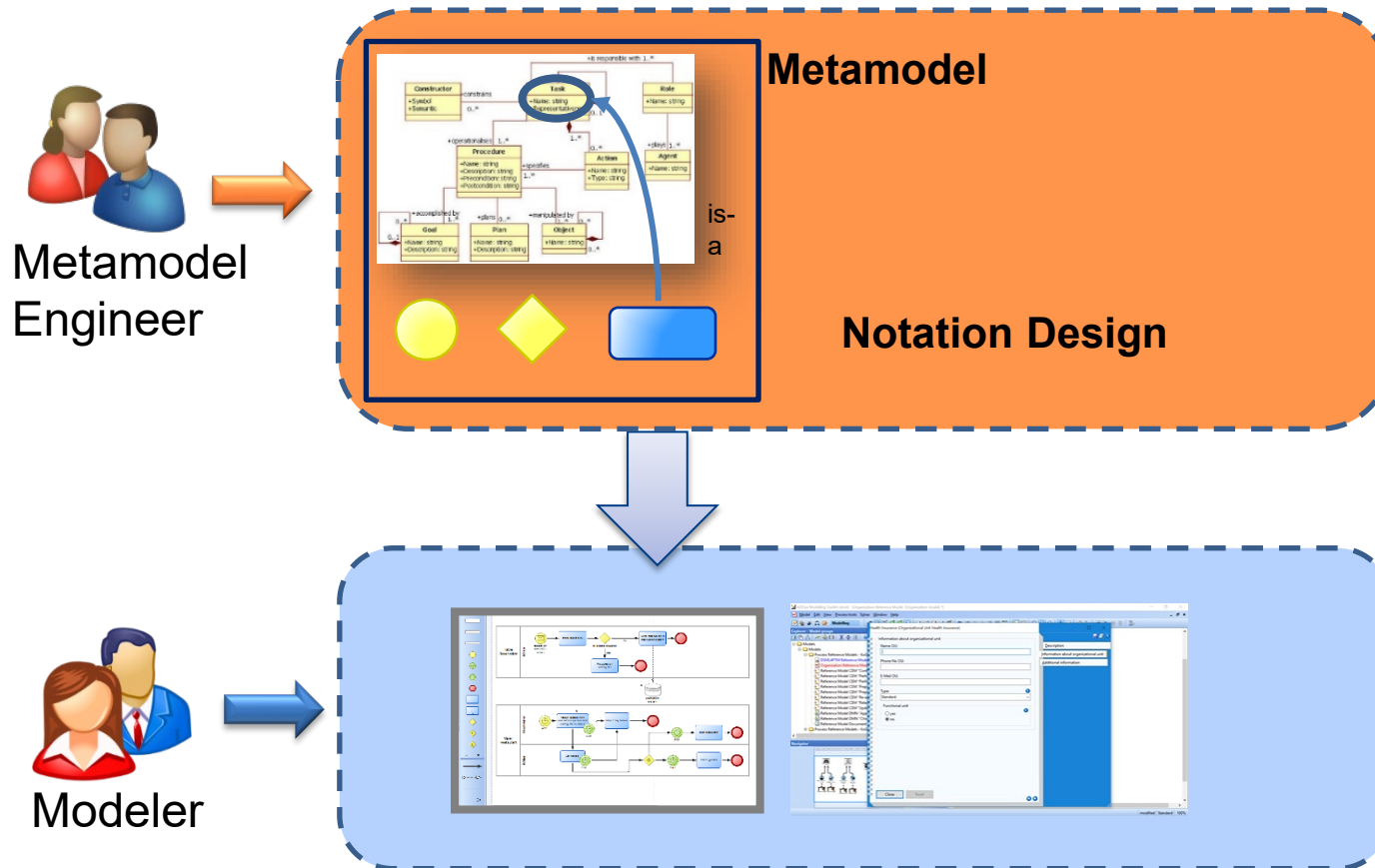


Image by [Bessi](#) from [Pixabay](#)

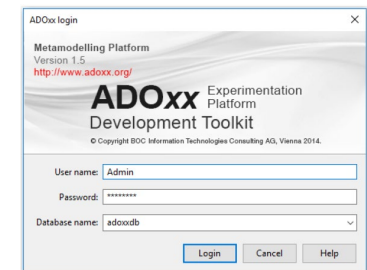
The ADOxx Environment

- ADOxx consists of ...
 - ◆ ADOxx Development Toolkit
 - Defining Modelling languages – Library Management
 - Administration of users, models, components
 - ◆ ADOxx Modelling Toolkit
 - Creating models

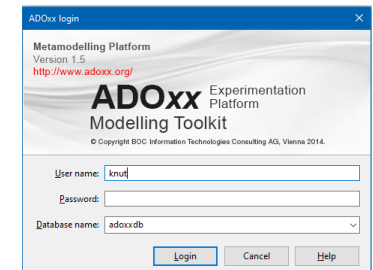
Modeling and Metamodeling



Meta-modeling

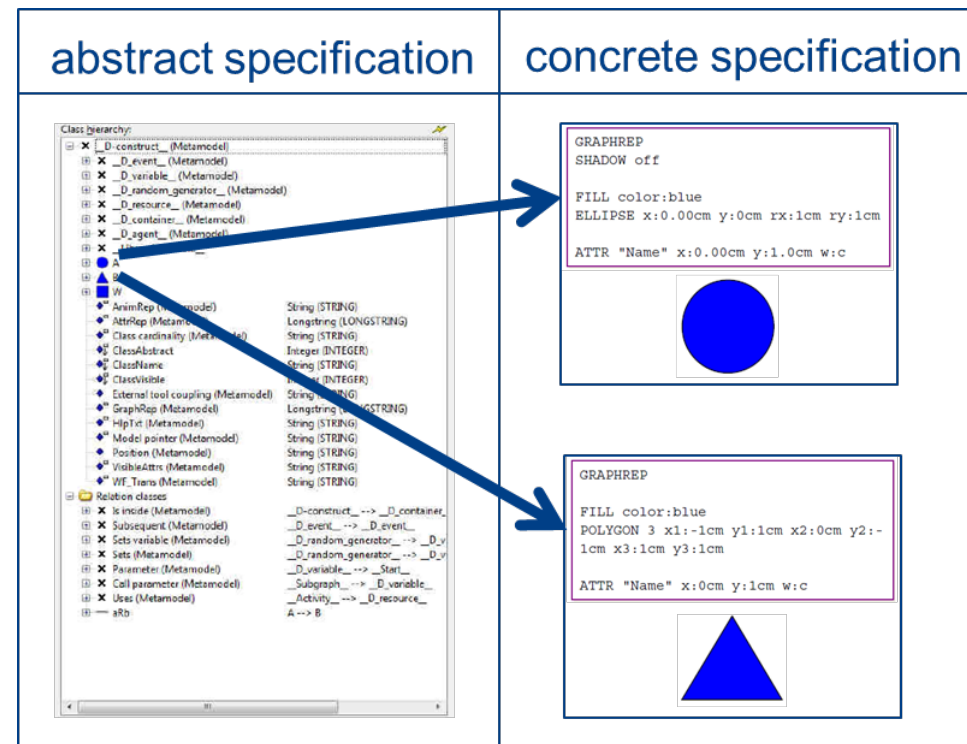


Modeling

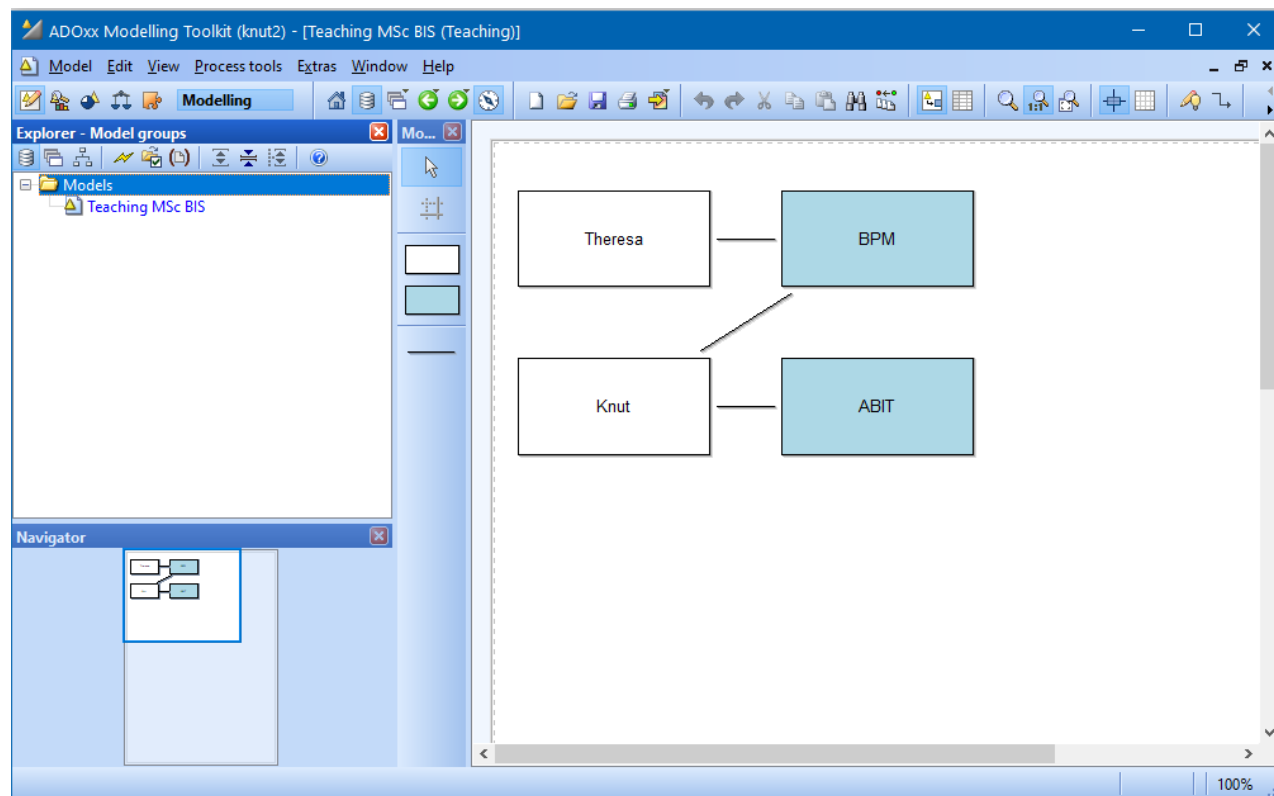


Metamodel and Modeling Language in ADOxx

- The meta model of a model language is defined by
 - ◆ Classes of elements and relations
 - ◆ Class hierarchy
 - ◆ Attributes of the elements
- The notation is defined by
 - ◆ special attribute GraphRep

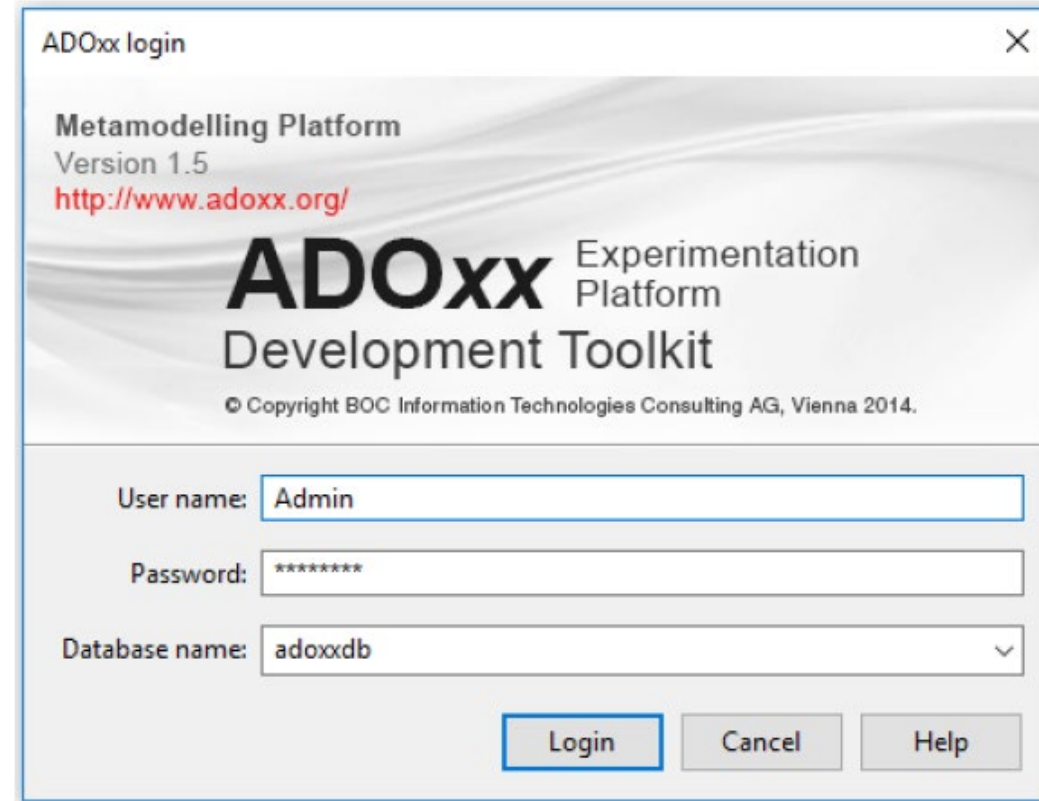


Example: Create a Modeling Language for Teaching



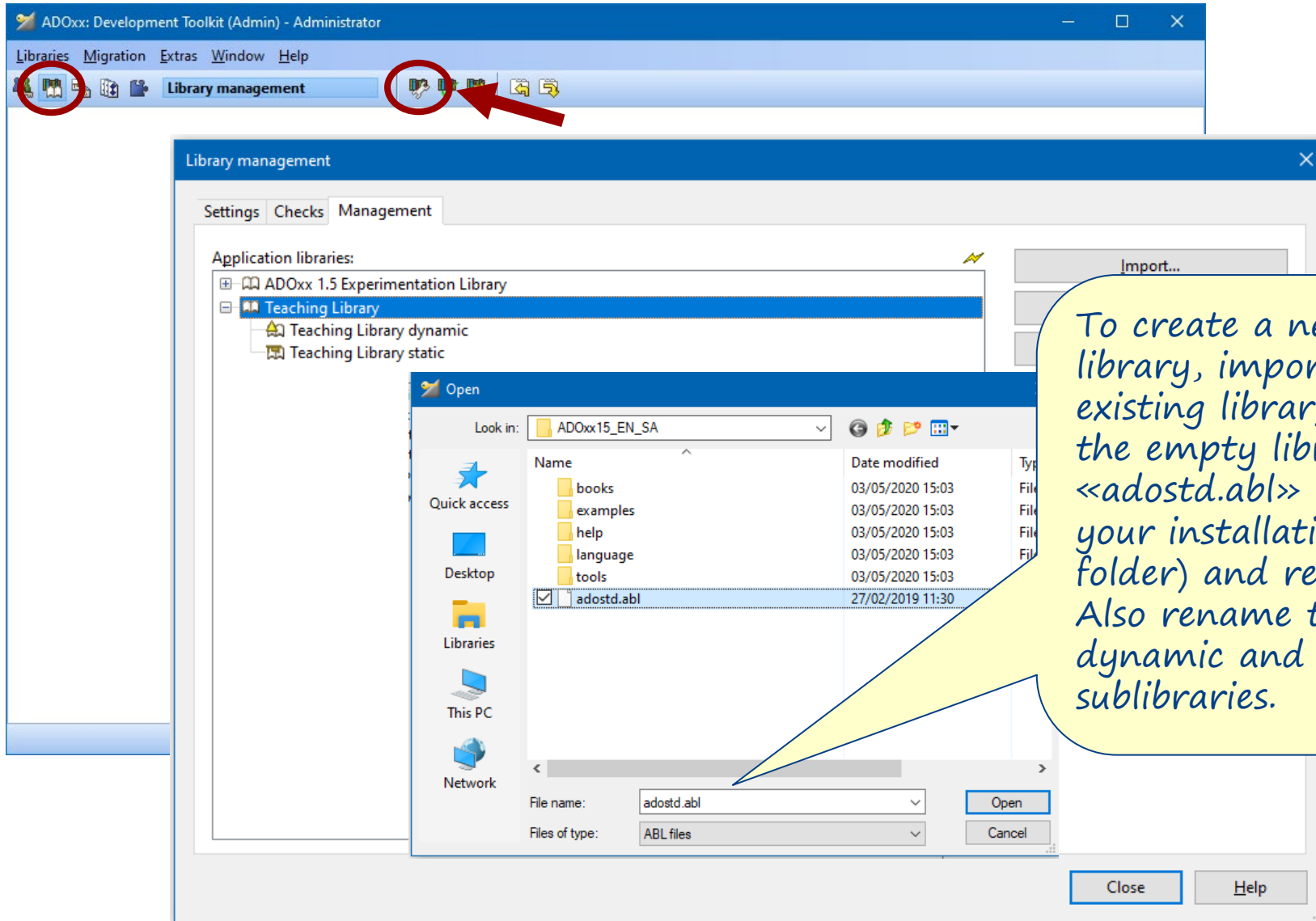
Development Toolkit

- Start Development Toolkit
- Login
 - ◆ Username: Admin
 - ◆ Password: password
 - ◆ DB: adoxxdb
(or the one you created during installation)

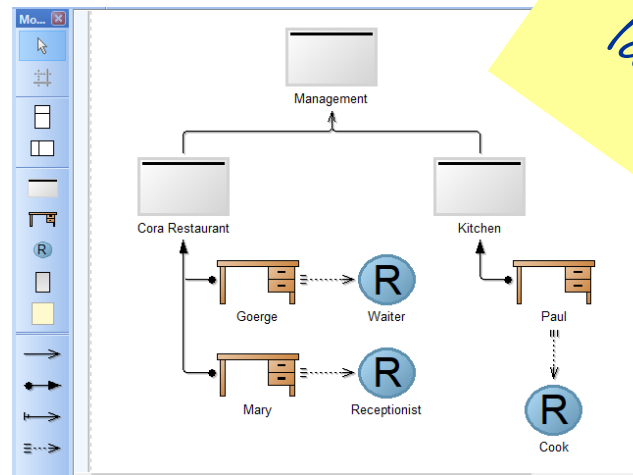
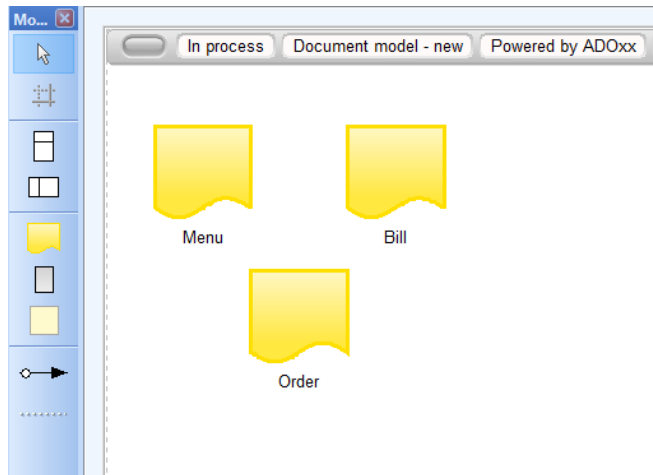
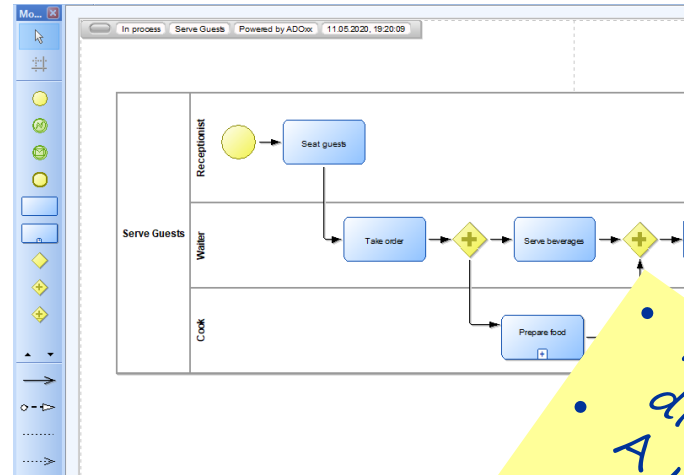
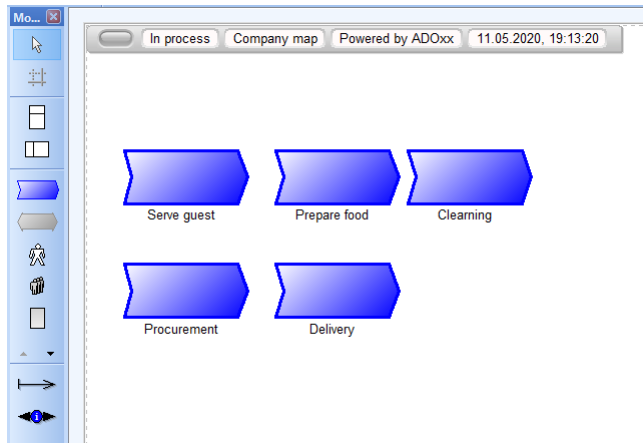


The screenshot shows a Windows-style login window titled "ADOxx login". The window has a close button (X) in the top right corner. The main content area has a light gray background with a wavy pattern. It displays the text "Metamodelling Platform", "Version 1.5", and the URL "http://www.adoxx.org/". Below this is the large "ADOxx" logo, followed by "Experimentation Platform" and "Development Toolkit". At the bottom of the main area, it says "© Copyright BOC Information Technologies Consulting AG, Vienna 2014." Below the main area is a white section containing three input fields: "User name:" with the text "Admin", "Password:" with masked characters "*****", and "Database name:" with a dropdown menu showing "adoxxdb". At the bottom right of the white section are three buttons: "Login" (highlighted with a blue border), "Cancel", and "Help".

Create a new Modeling Language Library



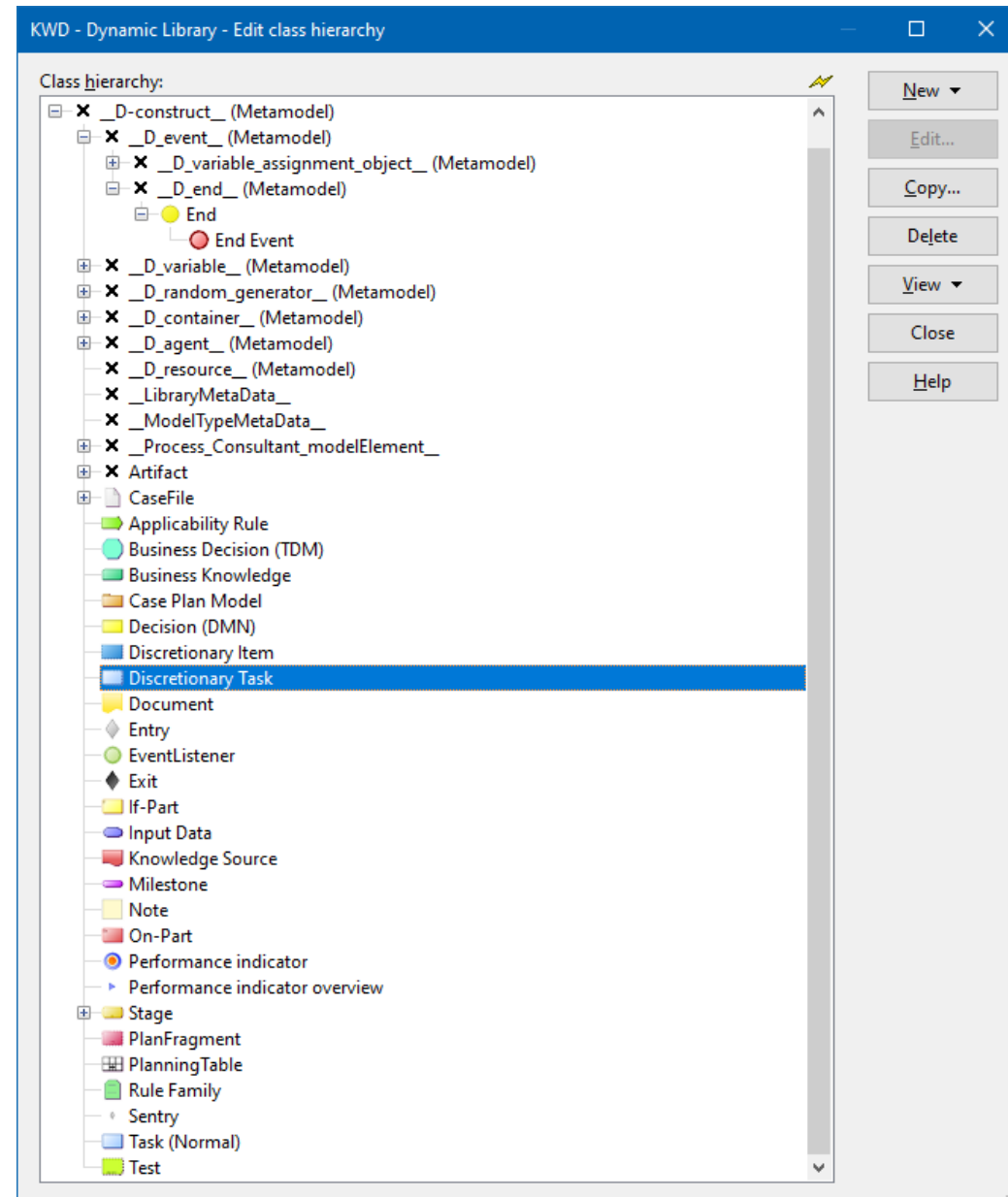
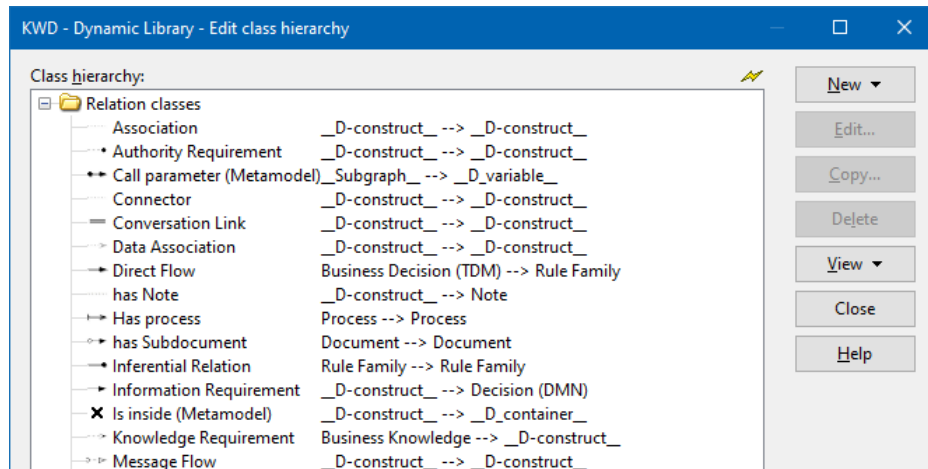
A Modeling Environment can consist of several Model Types



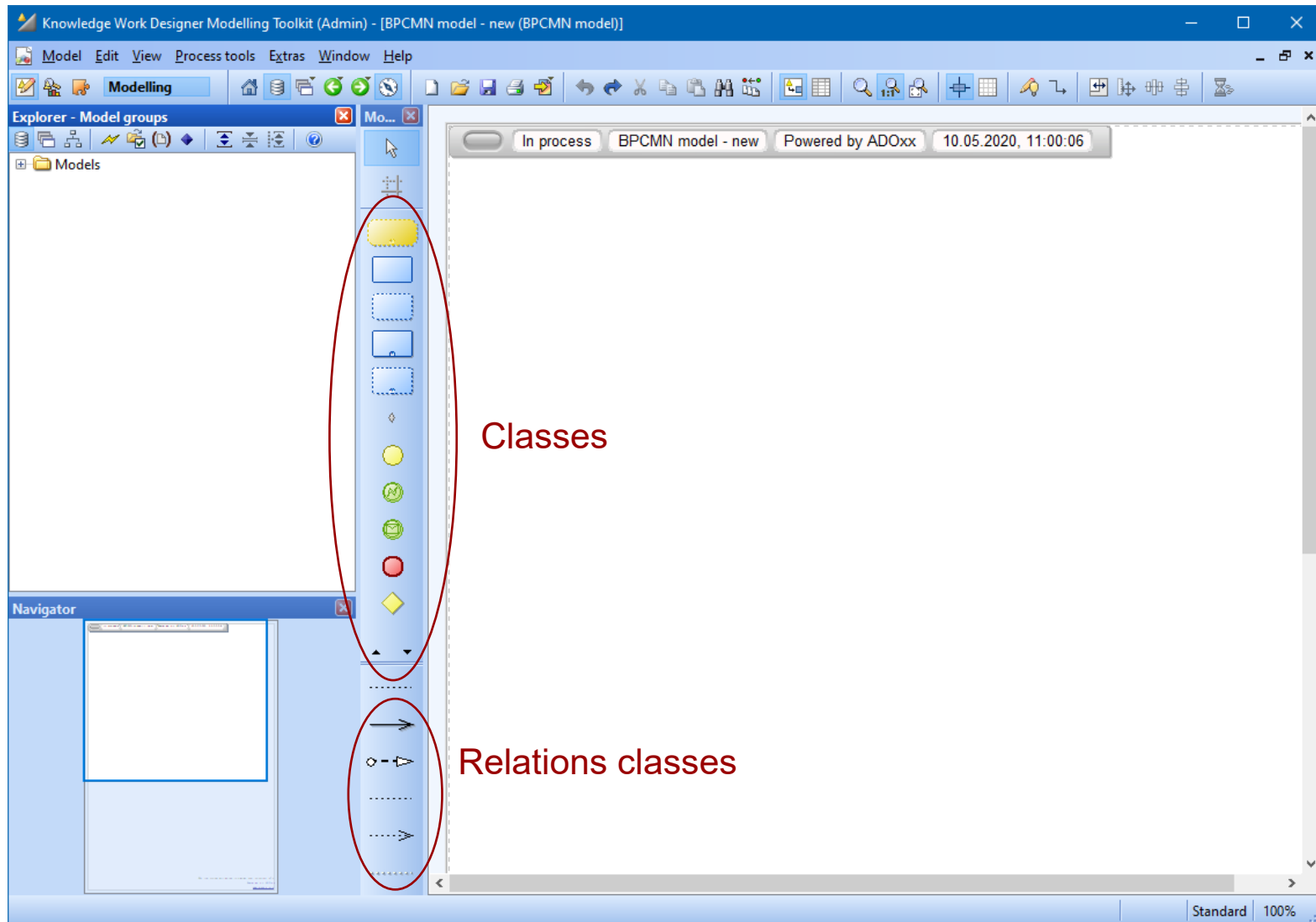
• Model Types represent different views
 • A model type can be regarded as a modeling language of its own.

Class Hierarchies

- ADOxx distinguishes
 - ◆ Classes
 - ◆ Relation classes



Appearance of Classes in the Modelling Toolkit



Creating new Classes

There are predefined abstract classes which have specific functionality

Teaching Library dynamic - Edit class hierarchy

Class hierarchy:

- ☒ **_D-construct_ (Metamodel)**
- ☒ _D_event_ (Metamodel)
- ☒ _D_variable_ (Metamodel)
- ☒ _D_random_generator_ (Metamodel)
- ☒ _D_resource_ (Metamodel)
- ☒ _D_container_ (Metamodel)
- ☒ _D_agent_ (Metamodel)
- ☒ _LibraryMetaData_
- ☒ _ModelTypeMetaData_
- ☒ AnimRep (Metamodel) STRING (Short string)
- ☒ AttrRep (Metamodel) LONGSTRING (Long string)
- ☒ Class cardinality (Metamodel) STRING (Short string)
- ☒ ClassAbstract INTEGER (Integer)
- ☒ ClassName STRING (Short string)
- ☒ ClassVisible INTEGER (Integer)
- ☒ External tool coupling (Metamodel) STRING (Short string)
- ☒ GraphRep (Metamodel) LONGSTRING (Long string)
- ☒ HlpTxt (Metamodel) STRING (Short string)
- ☒ Model pointer (Metamodel) STRING (Short string)
- ☒ Position (Metamodel) STRING (Short string)
- ☒ VisibleAttrs (Metamodel) STRING (Short string)
- ☒ WF_Trans (Metamodel) STRING (Short string)
- ☒ Relation classes

New ▾

- New class...**
- New attribute...
- New class attribute...

Delete

View ▾

- ☒ Classes
- ☒ Relation classes
- ☒ Metamodel
- ☒ Class hierarchy
- ☒ Attributes
- ☒ Attribute types
- ☒ Source and target classes
- IDs

Attributes

■ Kinds of Attributes

- ◆ Properties of Models
- ◆ Graphical Representation
- ◆ References

BPMN20_ADOxx13UL1_v1-01 Dynamic Library - Edit class hierarchy

Class hierarchy:

Task	
↳ _Conversion_	LONGSTRING (Long string)
↳ Aggregated costs	DOUBLE (Floating-point number)
↳ Aggregated execution time	TIME (Time)
↳ Aggregated personnel costs	DOUBLE (Floating-point number)
↳ Aggregated resting time	TIME (Time)
↳ Aggregated transport time	TIME (Time)
↳ Aggregated waiting time	TIME (Time)
↳ AnimRep (Metamodel)	STRING (Short string)
↳ Assignments (Metamodel)	RECORD (Record table)
↳ AttrRep (Metamodel)	LONGSTRING (Long string)
↳ Auditing	ENUMERATION (Enumeration)
↳ Average number of participants (Metamodel)	INTEGER (Integer)
↳ Beschreibung	STRING (Short string)
↳ Bezeichnung	STRING (Short string)
↳ Call activity	INTERREF (Inter-model reference)
↳ Cardinality	STRING (Short string)
↳ Categories (Metamodel)	STRING (Short string)
↳ Class cardinality (Metamodel)	STRING (Short string)
↳ ClassAbstract	INTEGER (Integer)
↳ Classification	ENUMERATIONLIST (Enumeration list)
↳ ClassName	STRING (Short string)
↳ ClassVisible	INTEGER (Integer)
↳ Collection	ENUMERATION (Enumeration)
↳ Comment	STRING (Short string)
↳ Completion condition	STRING (Short string)
↳ Continuous execution (Metamodel)	ENUMERATION (Enumeration)
↳ Cooperation mode (Metamodel)	ENUMERATION (Enumeration)
↳ Cooperative (Metamodel)	ENUMERATION (Enumeration)
↳ Costs	DOUBLE (Floating-point number)
↳ Description	STRING (Short string)
↳ Display responsible role	ENUMERATION (Enumeration)
↳ Documentation (Metamodel)	STRING (Short string)
↳ Doku	STRING (Short string)
↳ DokuSim	STRING (Short string)
↳ Done by (Metamodel)	STRING (Short string)
↳ EDP batch costs	DOUBLE (Floating-point number)
↳ EDP transaction costs	DOUBLE (Floating-point number)
↳ Execution interruptable (Metamodel)	ENUMERATION (Enumeration)
↳ Execution time (Metamodel)	TIME (Time)
↳ External documentation	PROGRAMCALL (Program call)
↳ External tool coupling (Metamodel)	STRING (Short string)
↳ fontcolor (Metamodel)	EXPRESSION (Expression)
↳ For compensation	ENUMERATION (Enumeration)
↳ Global task	ENUMERATION (Enumeration)
↳ GraphRep (Metamodel)	LONGSTRING (Long string)
↳ HlpTxt (Metamodel)	STRING (Short string)
↳ Id	EXPRESSION (Expression)
↳ Info on results	STRING (Short string)

New ▾
 Edit...
 Copy...
 Delete
 View ▾
 Close
 Help



Defining a GraphRep

With the help button you can define and test the graphics

GraphRep - Edit facets

Standard value:

```
GRAPHREP
FILL color:white
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
ATTR "Name" w:c h:c
```

Predefined value

Facets

Lecturer - GraphRep

Text:

```
GRAPHREP
FILL color:white
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
ATTR "Name" w:c h:c
```

Apply

Paint

Cancel

Module - GraphRep

Text:

```
GRAPHREP
FILL color:lightblue
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
ATTR "Name" w:c h:c
```

Apply

Paint

Cancel

Help

View:

Module

88 Character Ln 4, Col 14

90 Character Ln 4, Col 13

ATTR shows the value of the corresponding attribute (here <<Name>>)



References

Referencing a another model, e.g. a subprocess

Referenced subprocess - Edit facets

Standard value:

Attribute type:

INTERREF (Inter-model reference)

Predefined value

Facets

Close

Referenced subprocess - Edit facets

AttributeHelpText:

It is possible to reference a business process model, which is called by the current business process as a subprocess.

The reference can be selected or changed by clicking on the add-icon (symbol 'plus').

If the option 'Display name and reference' is disabled (default setting), the name of the referenced process will be displayed as a hyperlink beneath the object instead of the object name.

If the option 'Display name and reference' is enabled, the name of the referenced process will be displayed as a hyperlink beneath the object name in a smaller font size.

AttributeInterRefDomain:

REFDOMAIN max:1

MODREF

mt:"Business process diagram (BPMN 2.0)"

max:1

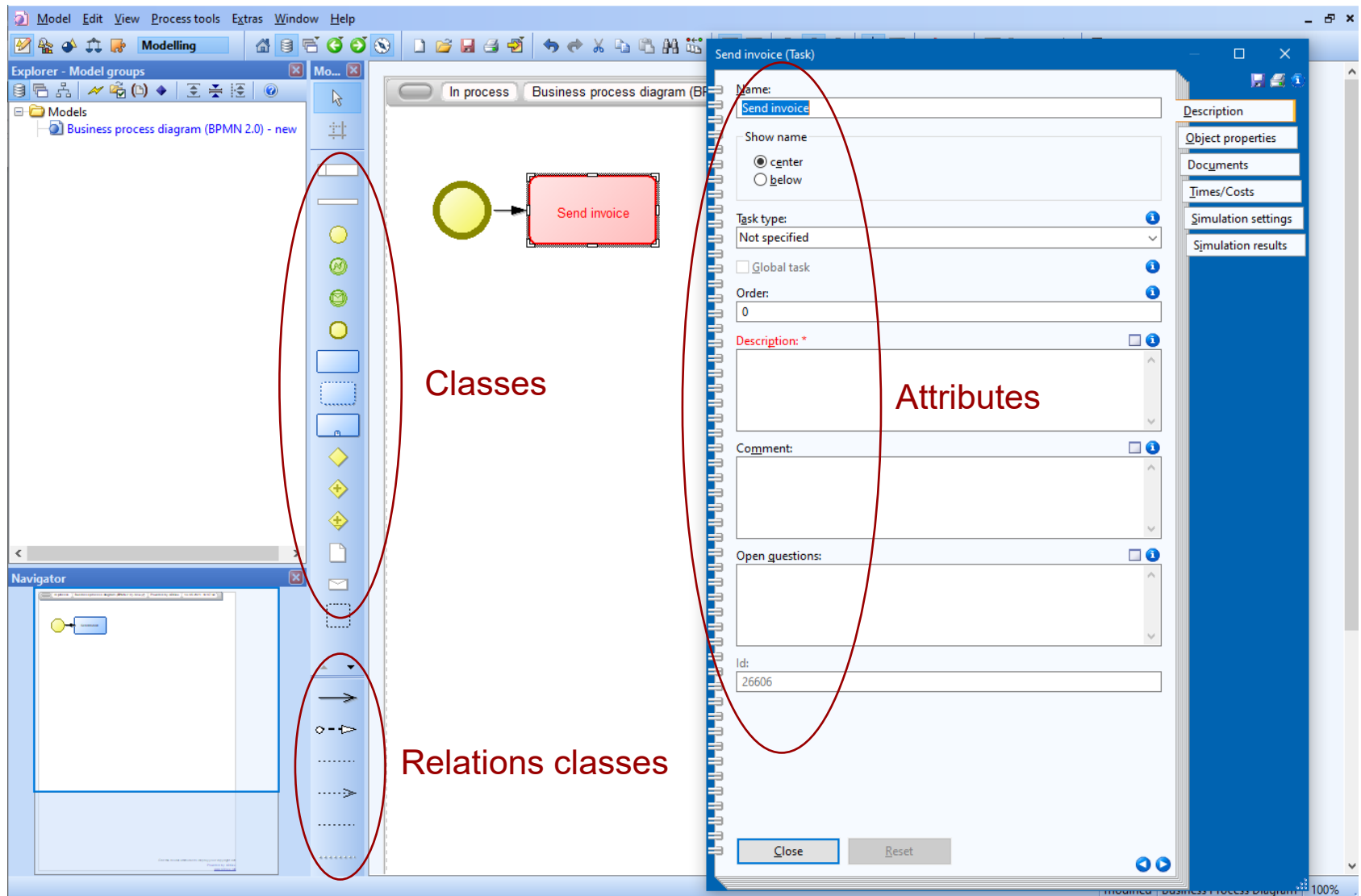
Predefined value

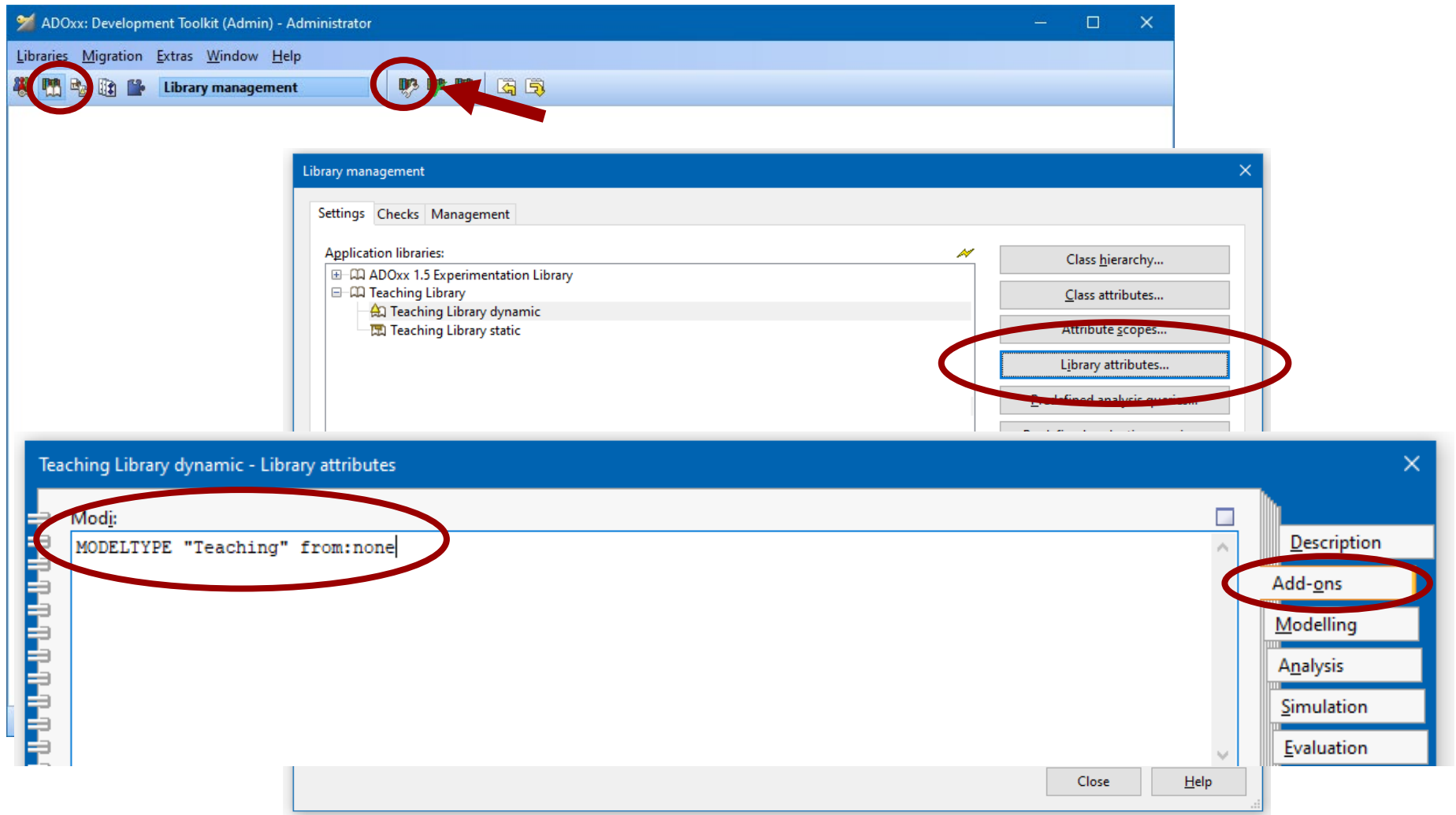
Facets

Close



Appearance of Attributes in the Modelling Toolkit





Creating new Classes

There are predefined abstract classes which have specific functionality

Teaching Library dynamic - Edit class hierarchy

Class hierarchy:

- ☒ **_D-construct_ (Metamodel)**
- ☒ **_D_event_ (Metamodel)**
- ☒ **_D_variable_ (Metamodel)**
- ☒ **_D_random_generator_ (Metamodel)**
- ☒ **_D_resource_ (Metamodel)**
- ☒ **_D_container_ (Metamodel)**
- ☒ **_D_agent_ (Metamodel)**
- ☒ **_LibraryMetaData_**
- ☒ **_ModelTypeMetaData_**
- ☒ **AnimRep (Metamodel)** STRING (Short string)
- ☒ **AttrRep (Metamodel)** LONGSTRING (Long string)
- ☒ **Class cardinality (Metamodel)** STRING (Short string)
- ☒ **ClassAbstract** INTEGER (Integer)
- ☒ **ClassName** STRING (Short string)
- ☒ **ClassVisible** INTEGER (Integer)
- ☒ **External tool coupling (Metamodel)** STRING (Short string)
- ☒ **GraphRep (Metamodel)** LONGSTRING (Long string)
- ☒ **HlpTxt (Metamodel)** STRING (Short string)
- ☒ **Model pointer (Metamodel)** STRING (Short string)
- ☒ **Position (Metamodel)** STRING (Short string)
- ☒ **VisibleAttrs (Metamodel)** STRING (Short string)
- ☒ **WF_Trans (Metamodel)** STRING (Short string)
- ☒ **Relation classes**

New ▾

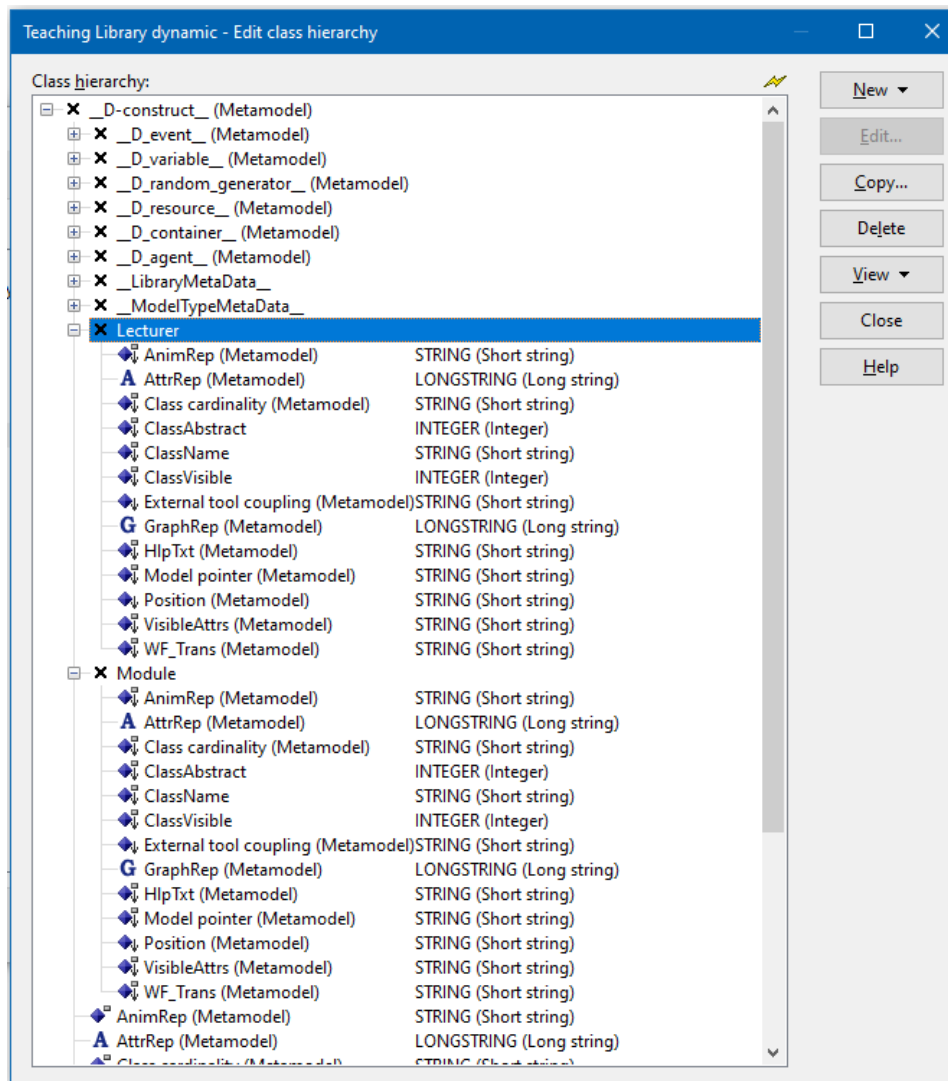
- New class...**
- New attribute...
- New class attribute...

Delete

View ▾

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- ☒ Relation classes
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- ☒ Class hierarchy
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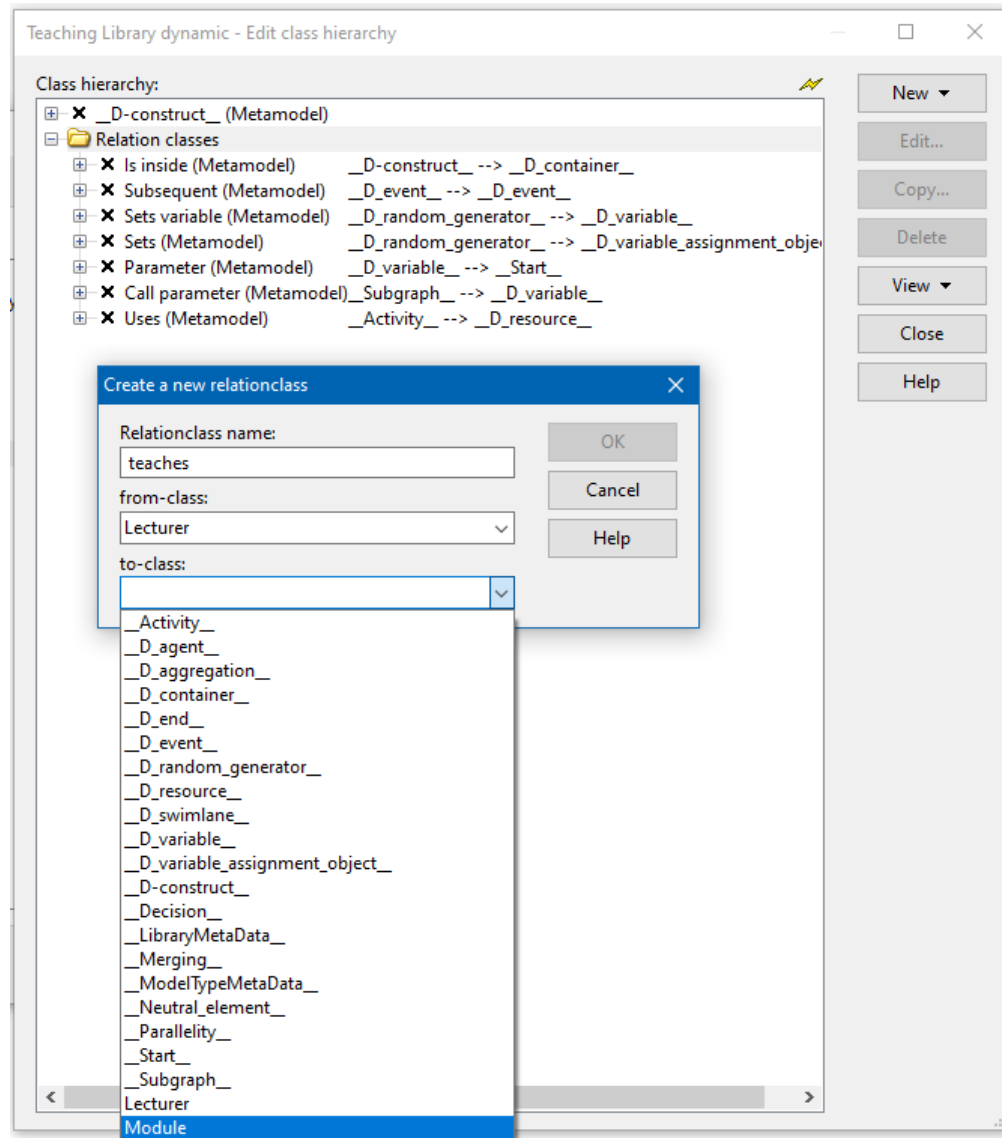
New Classes for Lecturer and Module



New classes, e.g. «Lecturer»
 and «Module» can be defined
 as subclasses of D-construct,
 if no specific functionality is
 needed.
 They inherit the attributes of
 the superclass

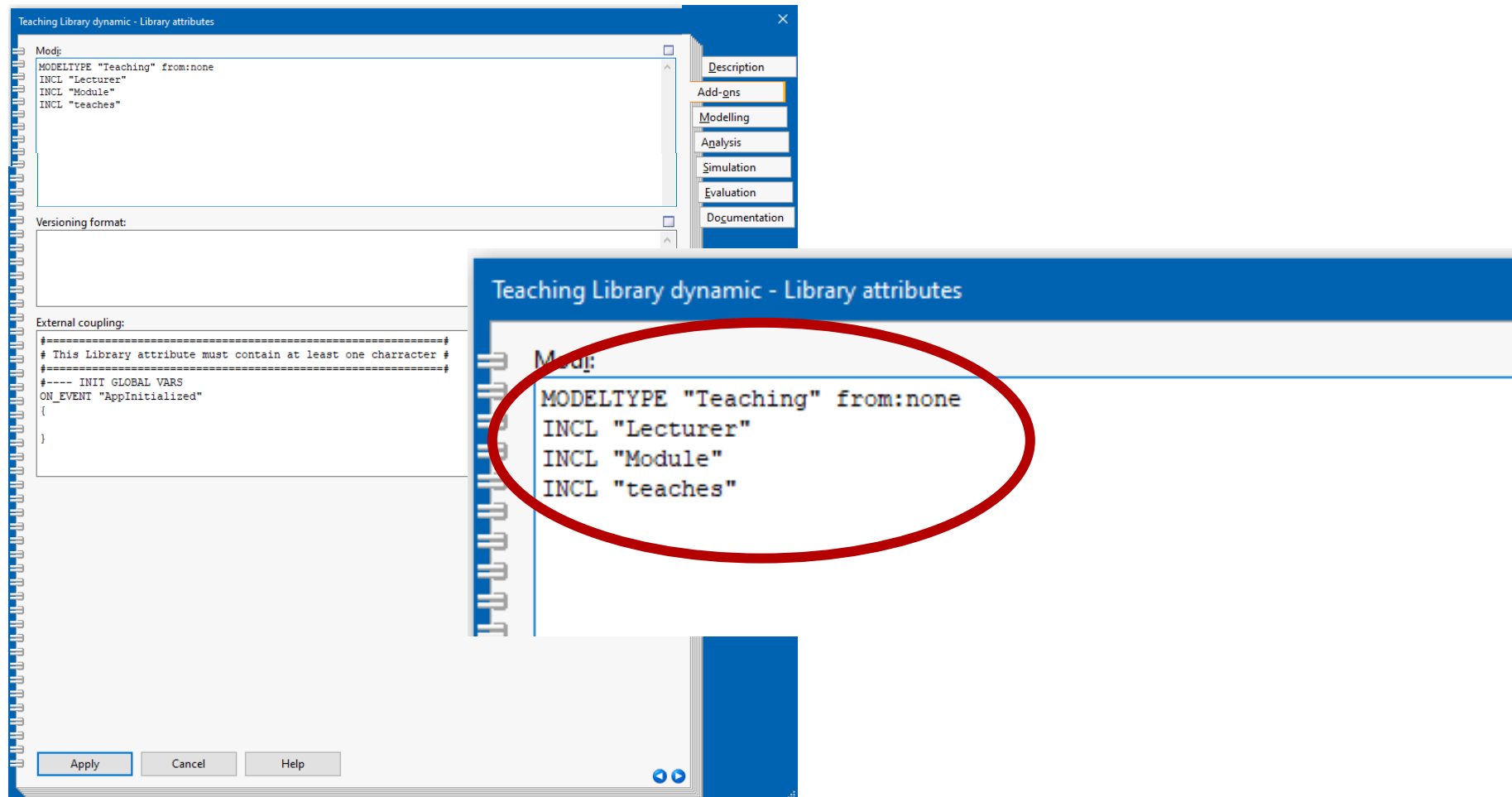


Defining a new Relation



Example: A new relation «teaches» for elements from class «Lecturer» to class «Module»

Classes and Relations are assigned to Model Types



Attributes

■ Kinds of Attributes

- ◆ Properties of Models
- ◆ Graphical Representation
- ◆ References

BPMN20_ADOxx13UL1_v1-01 Dynamic Library - Edit class hierarchy

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↳ Cooperation mode (Metamodel)	ENUMERATION (Enumeration)
↳ Cooperative (Metamodel)	ENUMERATION (Enumeration)
↳ Costs	DOUBLE (Floating-point number)
↳ Description	STRING (Short string)
↳ Display responsible role	ENUMERATION (Enumeration)
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↳ Doku	STRING (Short string)
↳ DokuSim	STRING (Short string)
↳ Done by (Metamodel)	STRING (Short string)
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↳ Execution interruptable (Metamodel)	ENUMERATION (Enumeration)
↳ Execution time (Metamodel)	TIME (Time)
↳ External documentation	PROGRAMCALL (Program call)
↳ External tool coupling (Metamodel)	STRING (Short string)
↳ fontcolor (Metamodel)	EXPRESSION (Expression)
↳ For compensation	ENUMERATION (Enumeration)
↳ Global task	ENUMERATION (Enumeration)
↳ GraphRep (Metamodel)	LONGSTRING (Long string)
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↳ Id	EXPRESSION (Expression)
↳ Info on results	STRING (Short string)

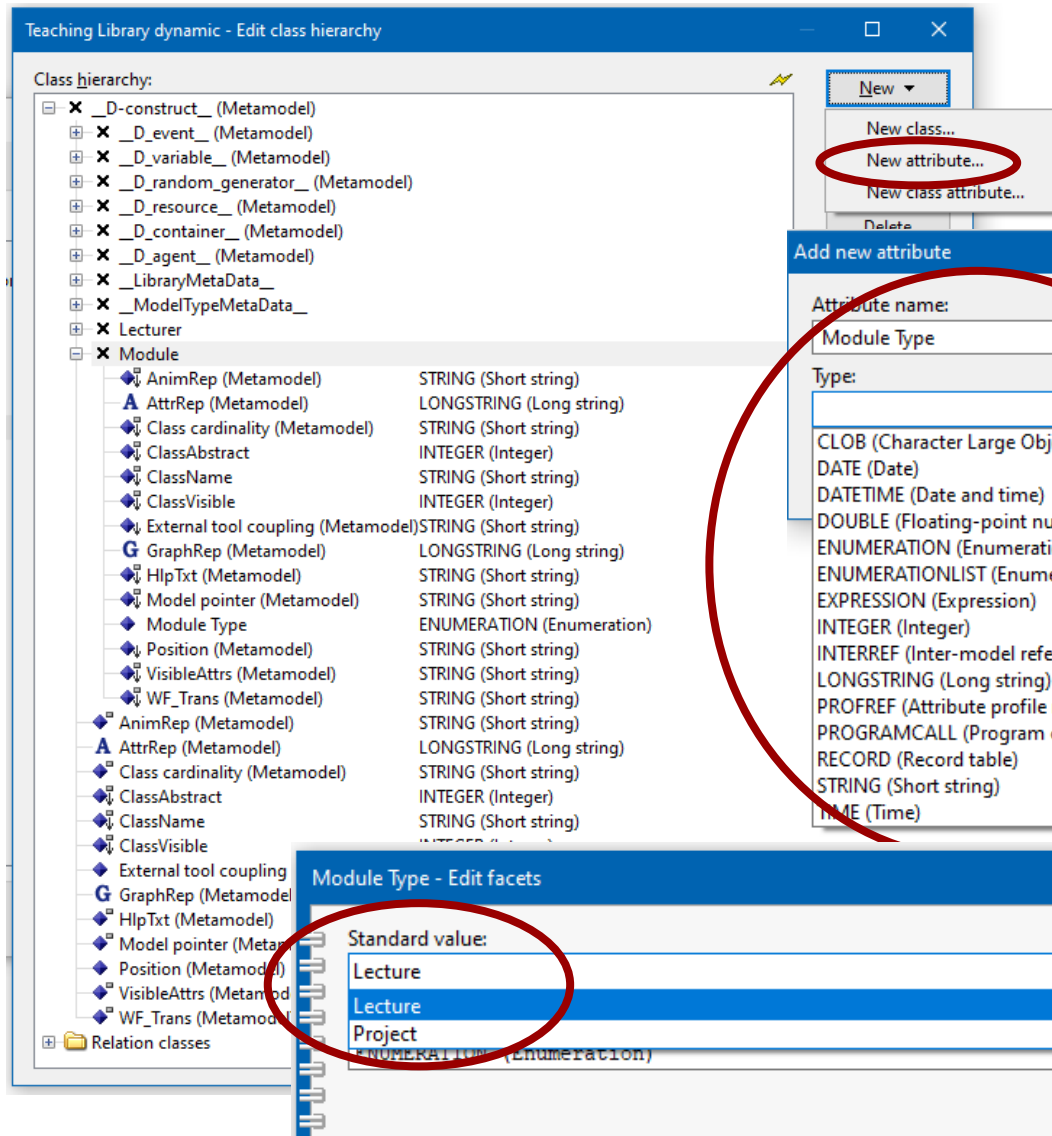
New ▾
 Edit...
 Copy...
 Delete
 View ▾
 Close
 Help



Defining a new Attribute

1. Select Class
2. Right Click or select «New Attribute ...»
3. Define Attribute

Example: Create an Enumeration Attribute to select type of modules as Lecture or Project



Teaching Library dynamic - Edit class hierarchy

Class hierarchy:

- [-] X __D-construct__ (Metamodel)
- [-] X __D_event__ (Metamodel)
- [-] X __D_variable__ (Metamodel)
- [-] X __D_random_generator__ (Metamodel)
- [-] X __D_resource__ (Metamodel)
- [-] X __D_container__ (Metamodel)
- [-] X __D_agent__ (Metamodel)
- [-] X __LibraryMetaData__
- [-] X __ModelTypeMetaData__
- [-] X Lecturer
- [-] X Module
 - [-] AnimRep (Metamodel) STRING (Short string)
 - [-] AttrRep (Metamodel) LONGSTRING (Long string)
 - [-] Class cardinality (Metamodel) STRING (Short string)
 - [-] ClassAbstract INTEGER (Integer)
 - [-] ClassName STRING (Short string)
 - [-] ClassVisible INTEGER (Integer)
 - [-] External tool coupling (Metamodel) STRING (Short string)
 - [-] GraphRep (Metamodel) LONGSTRING (Long string)
 - [-] HlpTxt (Metamodel) STRING (Short string)
 - [-] Model pointer (Metamodel) STRING (Short string)
 - [-] Module Type ENUMERATION (Enumeration)
 - [-] Position (Metamodel) STRING (Short string)
 - [-] VisibleAttrs (Metamodel) STRING (Short string)
 - [-] WF_Trans (Metamodel) STRING (Short string)
 - [-] AnimRep (Metamodel) STRING (Short string)
 - [-] AttrRep (Metamodel) LONGSTRING (Long string)
 - [-] Class cardinality (Metamodel) STRING (Short string)
 - [-] ClassAbstract INTEGER (Integer)
 - [-] ClassName STRING (Short string)
 - [-] ClassVisible
 - [-] External tool coupling
 - [-] GraphRep (Metamodel)
 - [-] HlpTxt (Metamodel)
 - [-] Model pointer (Metamodel)
 - [-] Position (Metamodel)
 - [-] VisibleAttrs (Metamodel)
 - [-] WF_Trans (Metamodel)
- [-] Relation classes

New

- New class...
- New attribute...
- New class attribute...
- Delete

Add new attribute

Attribute name: Module Type

Type:

- CLOB (Character Large Object)
- DATE (Date)
- DATETIME (Date and time)
- DOUBLE (Floating-point number)
- ENUMERATION (Enumeration)
- ENUMERATIONLIST (Enumeration list)
- EXPRESSION (Expression)
- INTEGER (Integer)
- INTERREF (Inter-model reference)
- LONGSTRING (Long string)
- PROFREF (Attribute profile reference)
- PROGRAMCALL (Program call)
- RECORD (Record table)
- STRING (Short string)
- TIME (Time)

Module Type - Edit facets

Standard value:

- Lecture
- Lecture
- Project

Predefined value

Facets



Defining a GraphRep

With the help button you can define and test the graphics

GraphRep - Edit facets

Standard value:

```
GRAPHREP
FILL color:white
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
TEXT "Lecturer" w:c h:c
```

Lecturer - GraphRep

Text:

```
GRAPHREP
FILL color:white
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
TEXT "Lecture" w:c h:c
```

Apply
Paint
Cancel

Module - GraphRep

Text:

```
GRAPHREP
FILL color:lightblue
RECTANGLE x:-2cm y:-1cm w:4cm h:2cm
TEXT "Module" w:c h:c
```

View:

Apply
Paint
Cancel
Help

88 Character Ln 4, Col 14

90 Character Ln 4, Col 13

Predefined value
Facets

TEXT shows a standard text, ATTR shows the names of the corresponding attribute

