

The Use of AutomationML in the Engineering of Building Automation Systems

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- 1. Basic information**
- 2. Motivation**
- 3. Systematic approach**
- 4. Requirements engineering**
- 5. Simulation und Design**
- 6. Summary**

VDI 3814: functions for building automation (BA) (measurement, optimizing, management ...)

Examples for measurement

- runtime monitoring
- event counting
- ...

Examples for management, optimizing

- night cooling
- energy reclaiming
- ...

VDI 3813: functions for room automation (RA) (sensor-, actuator-, application functions)

Examples for sensor functions

- presence detection
- window monitoring
- ...

Examples for application functions

- occupancy evaluation
- energy mode selection
- ...

Examples for operator functions

- signal presence
- adjust temperature setpoint
- ...

Examples for actuator functions

- light actuator
- control drive actuator
- ...

Dewpoint
Automatic
Partition Light
Time Brightness
Constant-light Air
BA/RA-Functions
Wind Precipitation Fan
Night-time Light
Air Stairwell
Presence
Twilight

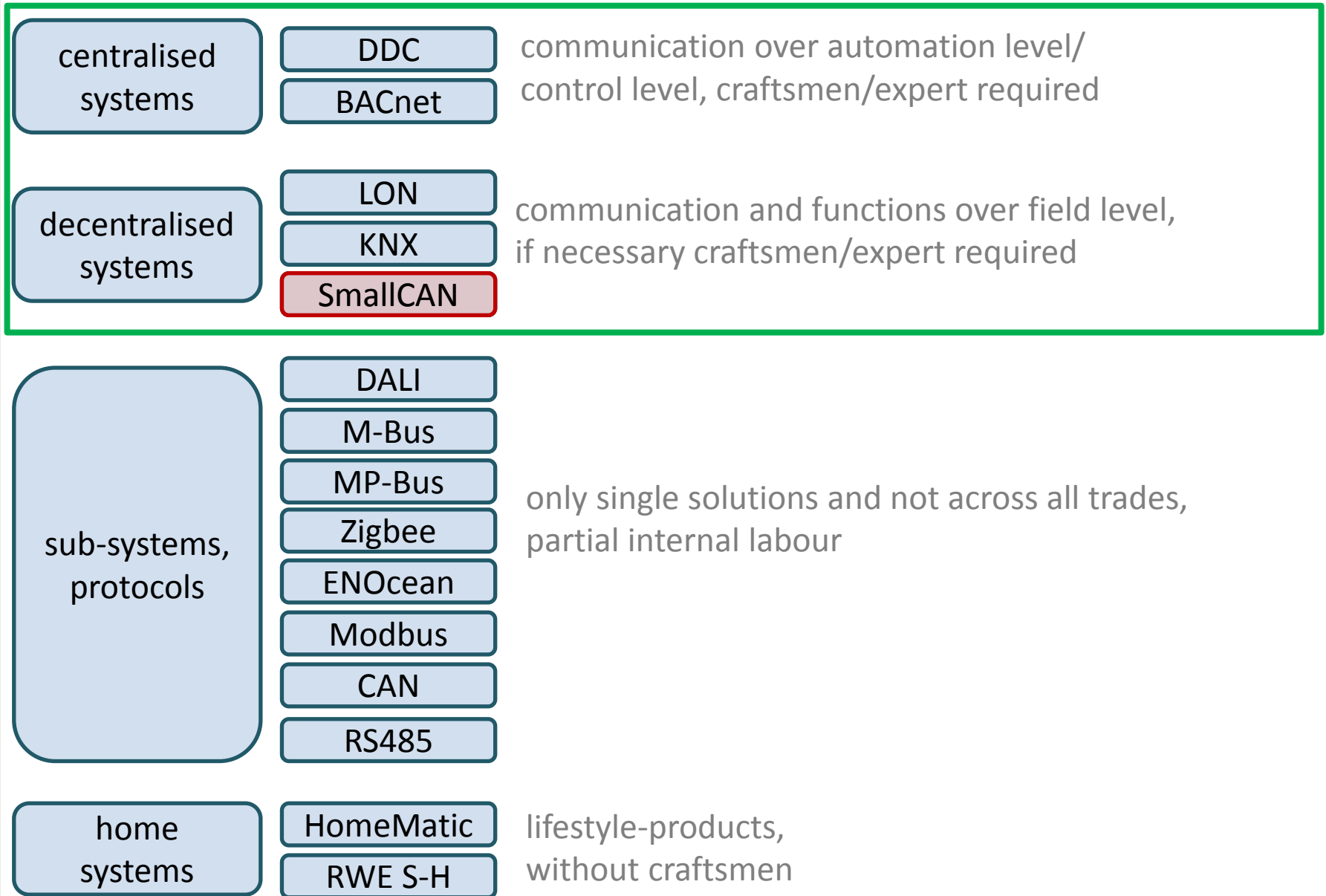
across all trades

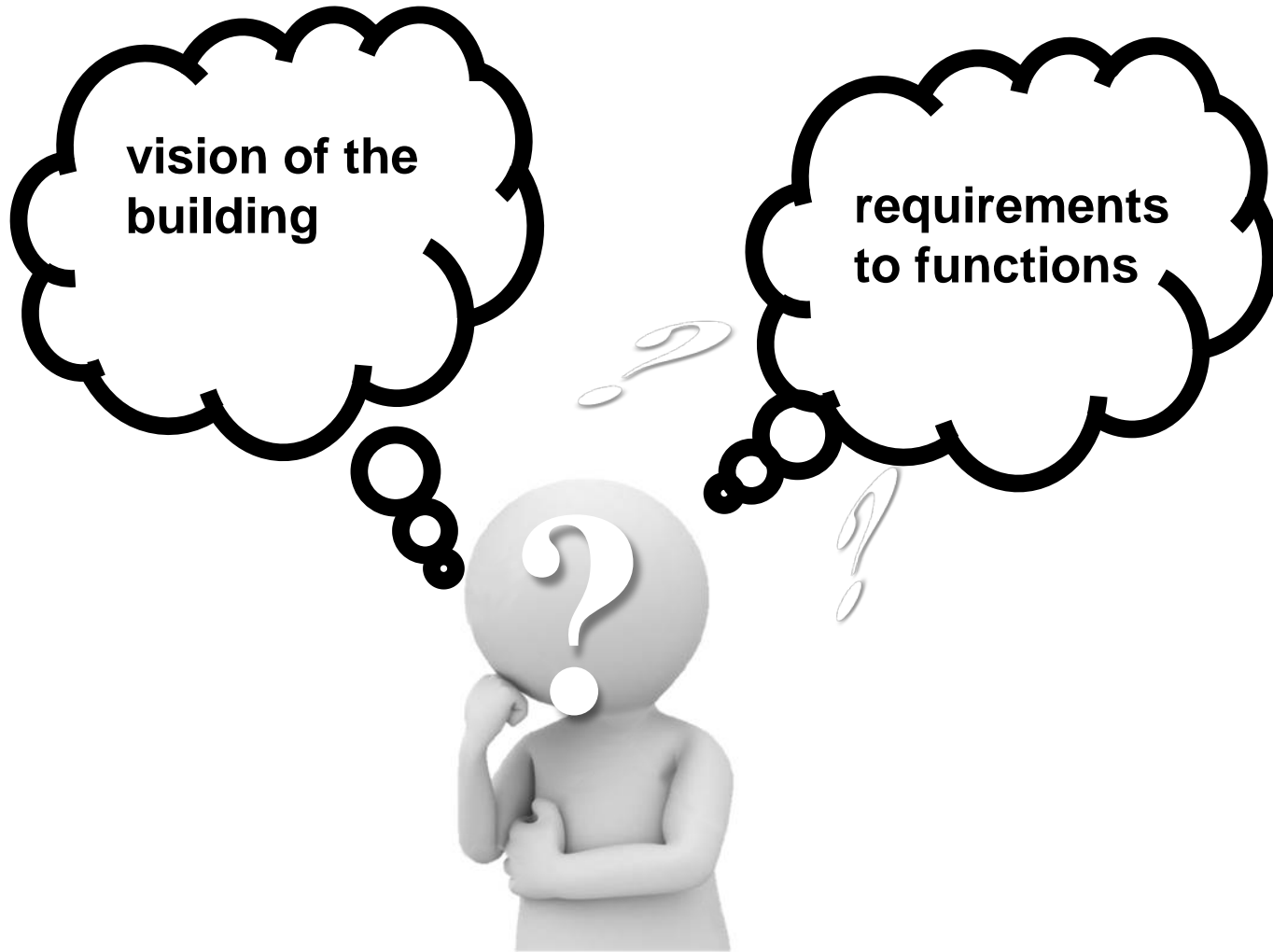


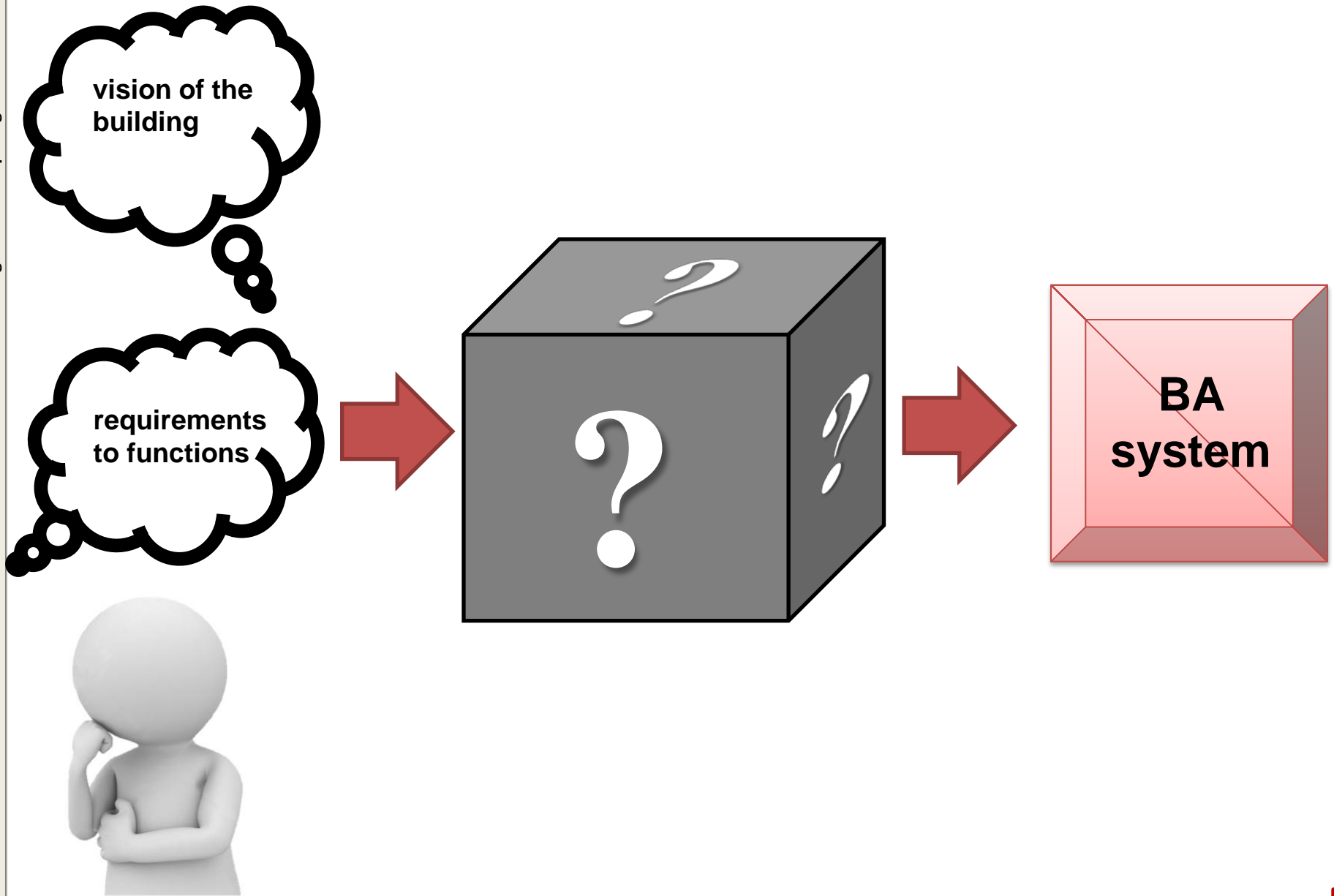
complex functions



expensive re-planning



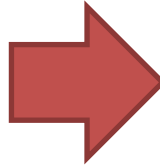




Target is:



- Ideal
- Functional
- Energy efficient
- Coast efficient



Approach:

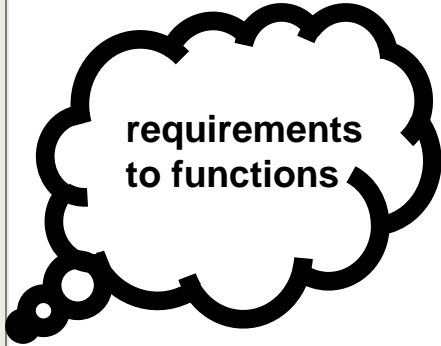
- „Virtual commissioning“
- Simulation
- Automatic modell generation
- Automatic parametrisation

BA system

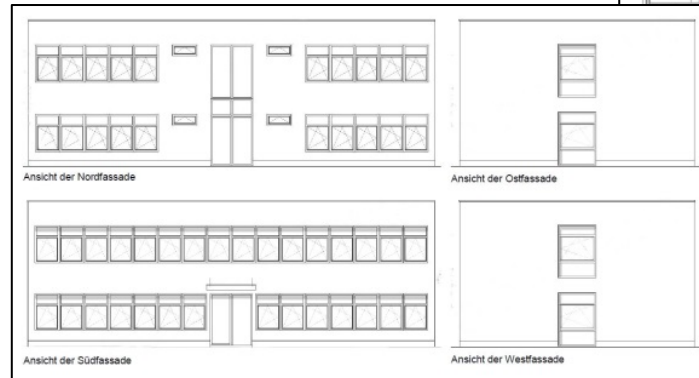
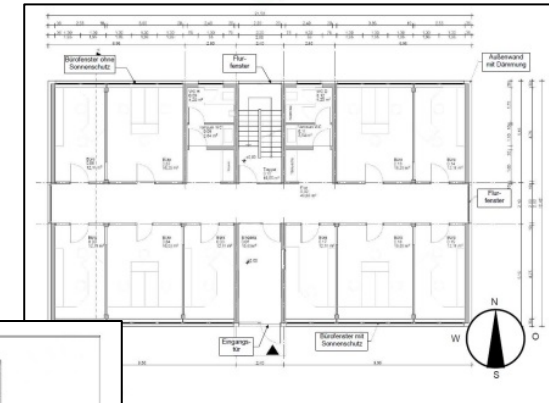


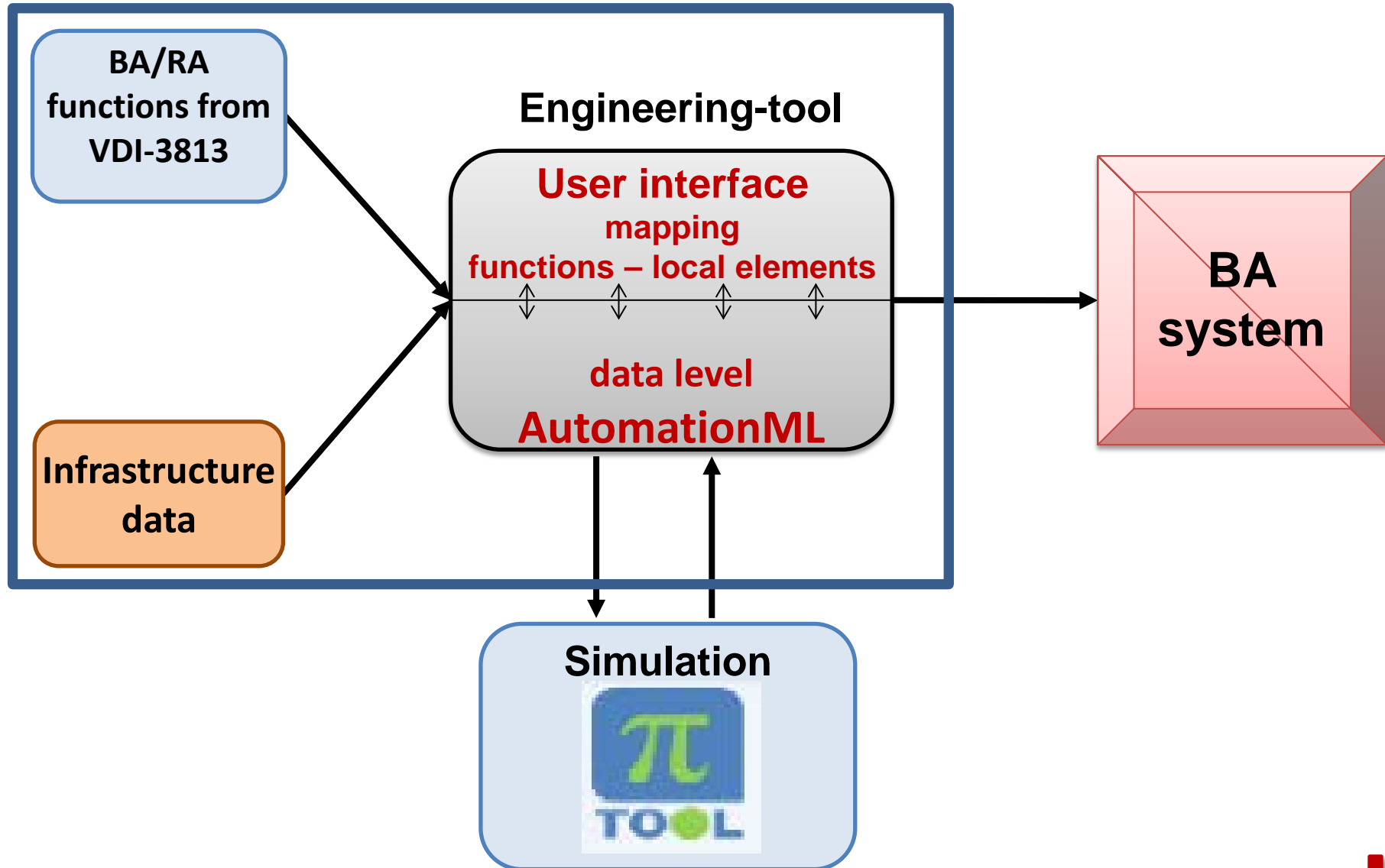
**BA/RA
functions from
VDI-3813**

Dewpoint
Automatic
Partition
TimeBrightness
Constant-light
Air
BA/RA-Functions
WindPrecipitation
Night-timeLight
Air Stairwell
Presence
Twilight

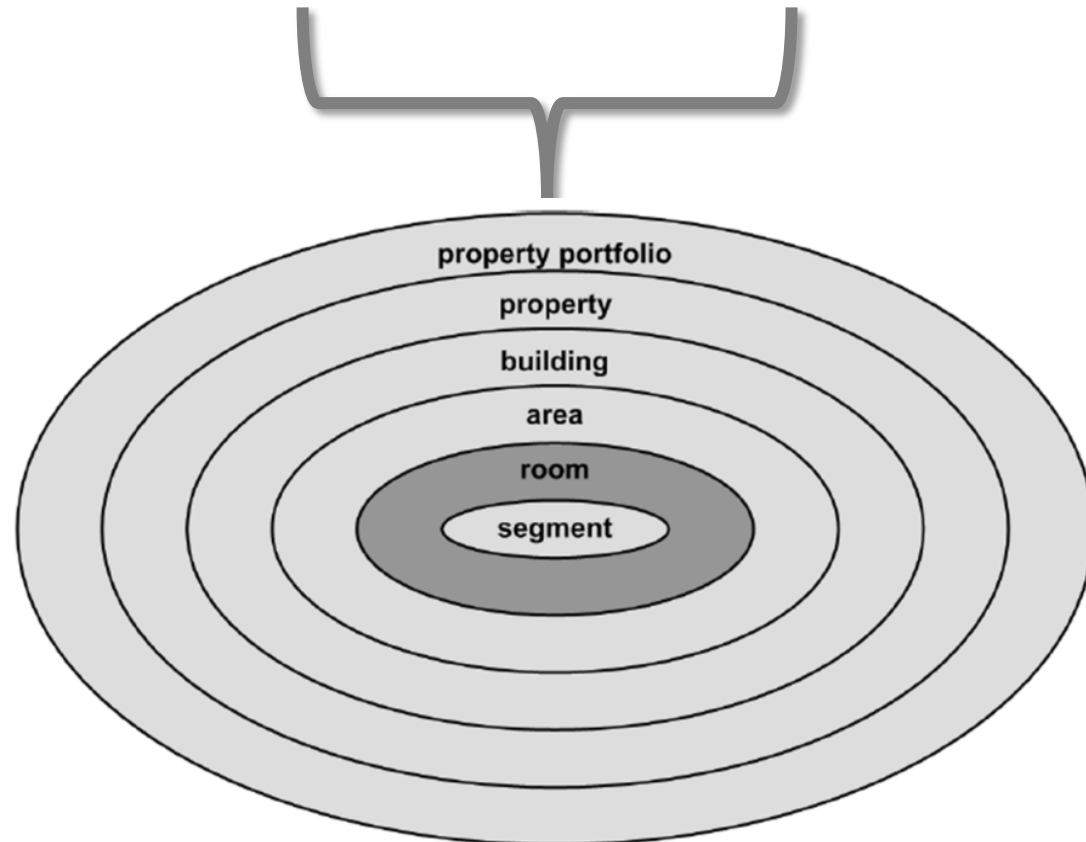
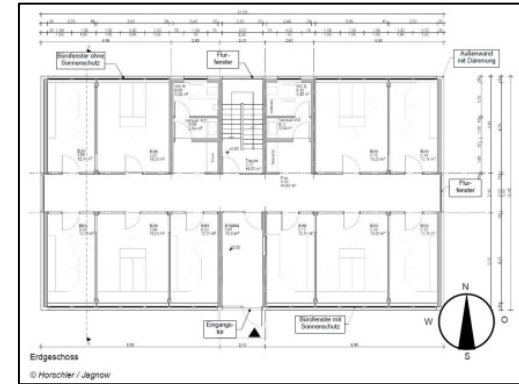
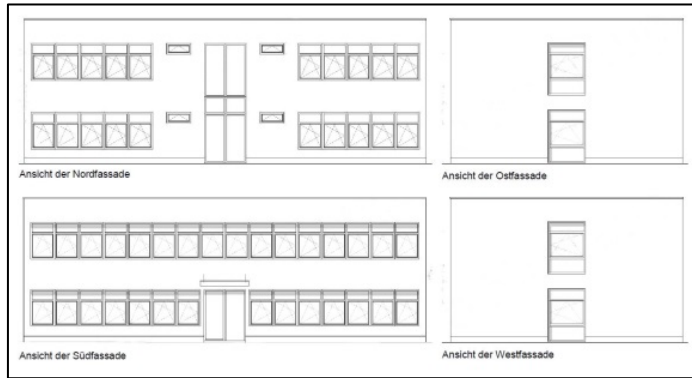


**Infrastructure
data**

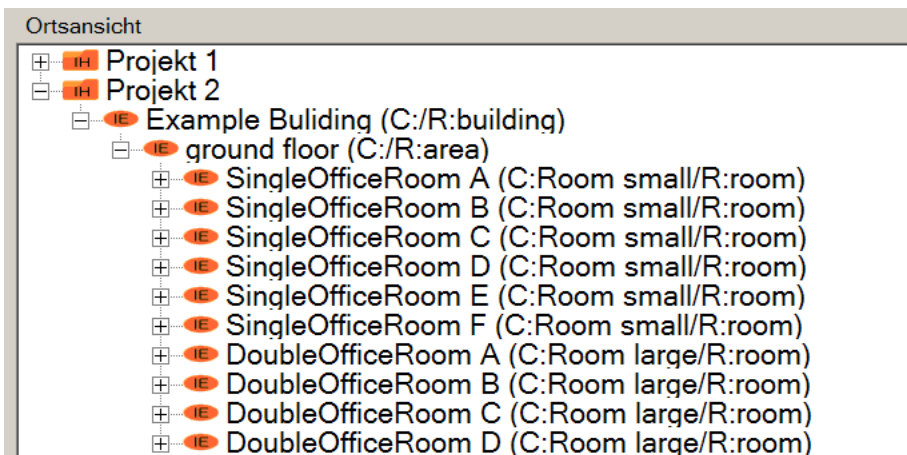
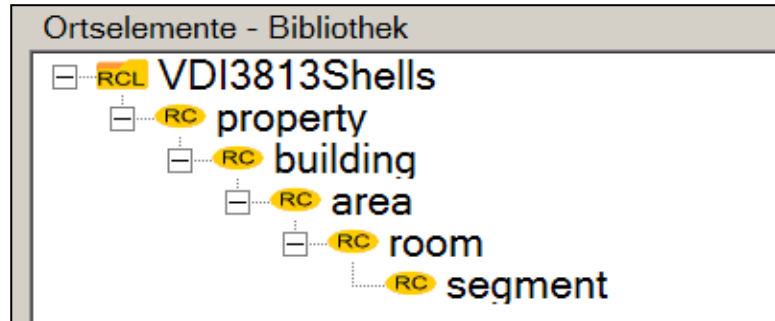




Infrastructure data



Infrastructure data

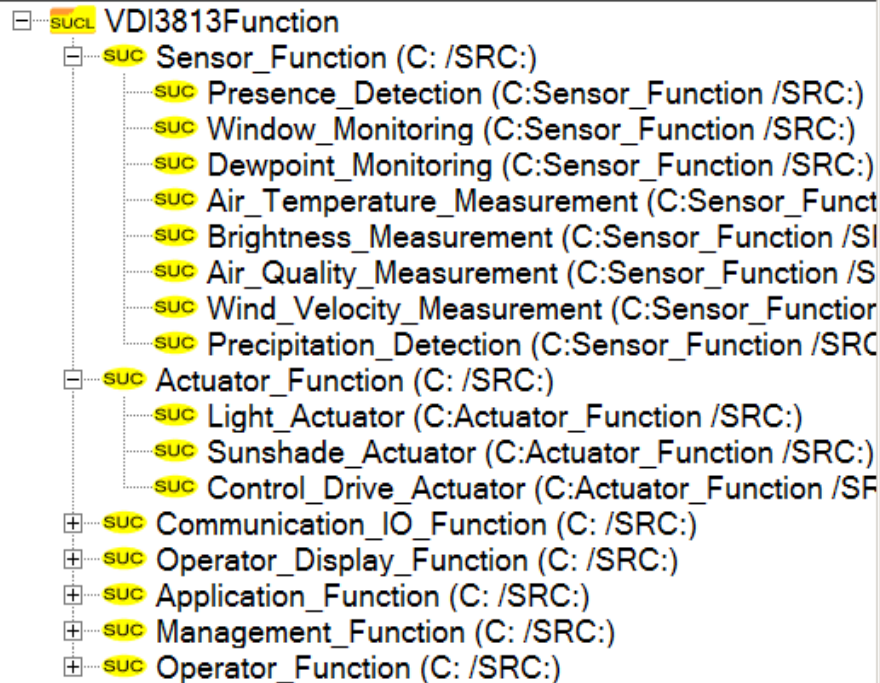


- ***RoleClassLibrary*** for local elements
- **Basis: shell modell from VDI-Guideline 3813**

- ***InstanceHierarchy***
- **Mapping of functions with local elements**
- **Complete BA system**

**BA/RA
functions from
VDI-3813**

Funktionen - Bibliothek

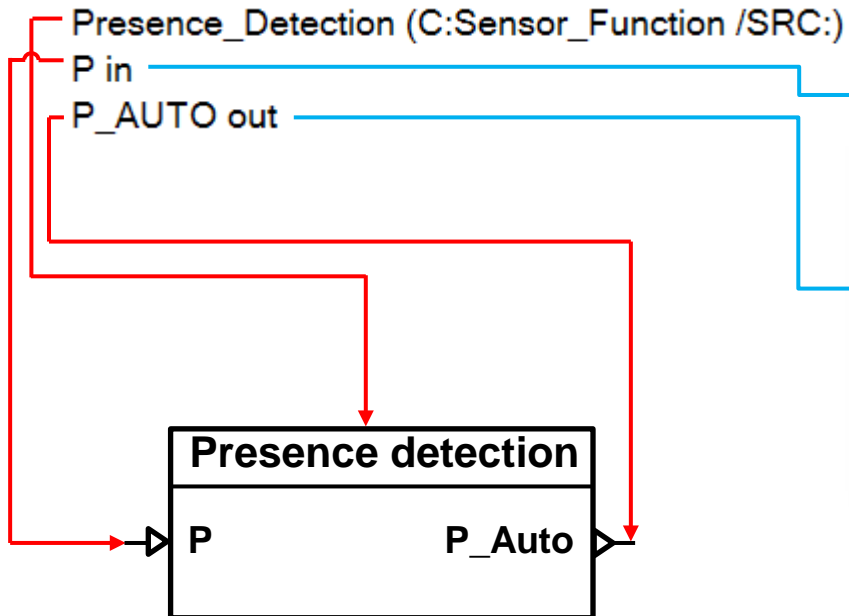


- Functions stored in *SystemUnitClassLibrary*
- Different function libraries possible
- Input of parameter over *attributes*
- Links between functions over *Interfaces* and *InternalLinks*

BA/RA
functions from
VDI-3813

Engineering-Tool

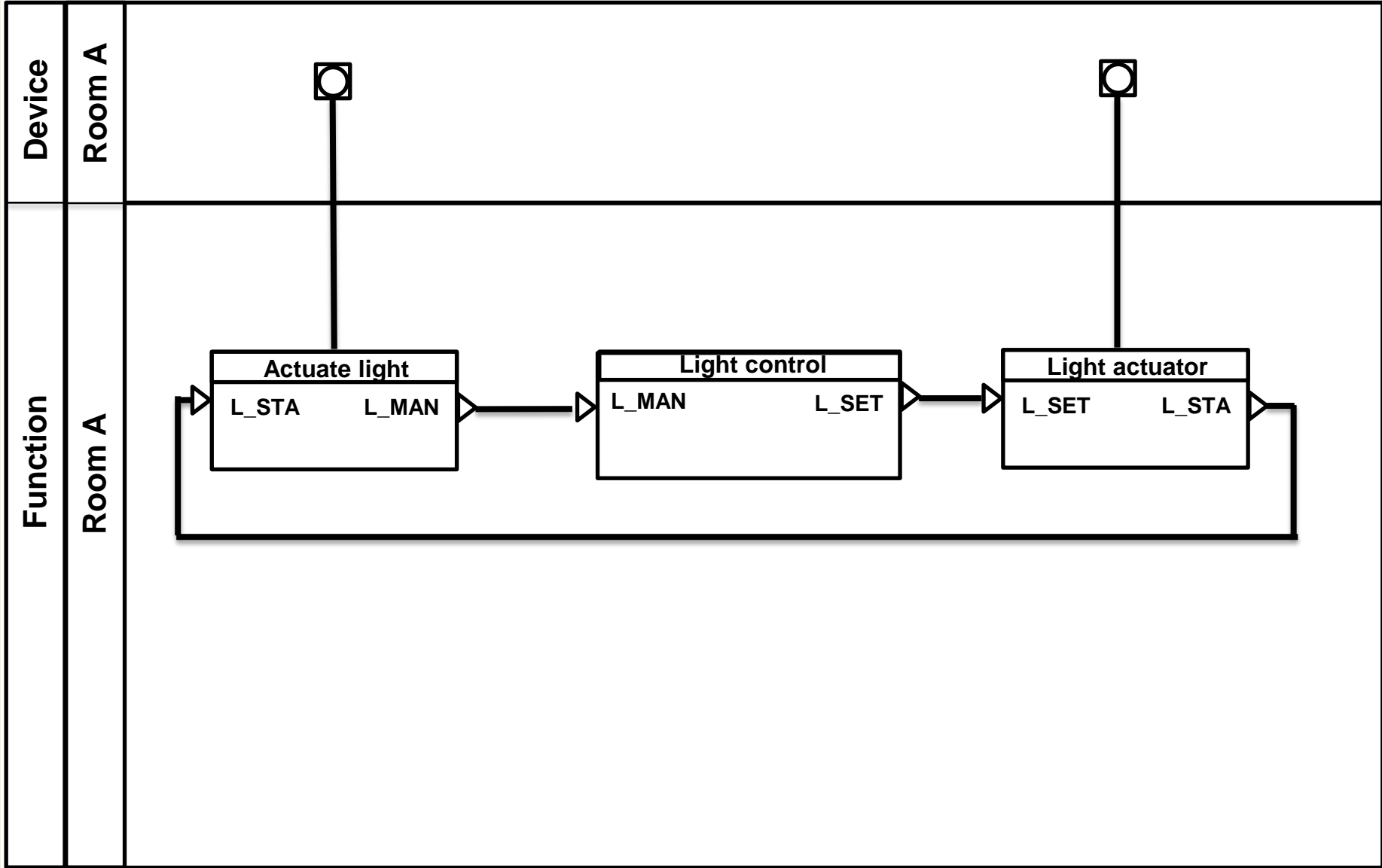
AutomationML



```

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<InternalElement Name="Presence_Detection" RefBaseSystemUnitPath="iQSTFunc
  <Attribute Name="PAR_HOLD" AttributeDataType="xs:string" />
  <ExternalInterface Name="P" RefBaseClassPath="AutomationMLInterfaceClass
    <Attribute Name="Type" AttributeDataType="xs:string">
    <Attribute Name="Direction" AttributeDataType="xs:string">
    <Attribute Name="BitCount" AttributeDataType="xs:uint">
    <Attribute Name="Orientation" AttributeDataType="xs:string">
    <Attribute Name="Range" AttributeDataType="xs:complex">
  </ExternalInterface>
  <ExternalInterface Name="P_AUTO" RefBaseClassPath="AutomationMLInterface
    <Attribute Name="Type" AttributeDataType="xs:string">
    <Attribute Name="Direction" AttributeDataType="xs:string">
    <Attribute Name="BitCount" AttributeDataType="xs:uint">
    <Attribute Name="Orientation" AttributeDataType="xs:string">
    <Attribute Name="Range" AttributeDataType="xs:complex">
  </ExternalInterface>
</InternalElement>
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  <Attribute Name="PAR_HOLD" AttributeDataType="xs:string" />
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    <Attribute Name="Type" AttributeDataType="xs:string">
    <Attribute Name="Direction" AttributeDataType="xs:string">
    <Attribute Name="BitCount" AttributeDataType="xs:uint">
    <Attribute Name="Orientation" AttributeDataType="xs:string">
    <Attribute Name="Range" AttributeDataType="xs:complex">
  </ExternalInterface>
  <ExternalInterface Name="P_AUTO" RefBaseClassPath="AutomationMLInterface
    <Attribute Name="Type" AttributeDataType="xs:string">
    <Attribute Name="Direction" AttributeDataType="xs:string">
    <Attribute Name="BitCount" AttributeDataType="xs:uint">
    <Attribute Name="Orientation" AttributeDataType="xs:string">
    <Attribute Name="Range" AttributeDataType="xs:complex">
  </ExternalInterface>
</InternalElement>
  
```

Function block from VDI-Guideline 3813





■ Tool-Presentation

Internal Links

- links between functions

InterfaceClass-Library

- Interfaces for links

InstanceHierarchy

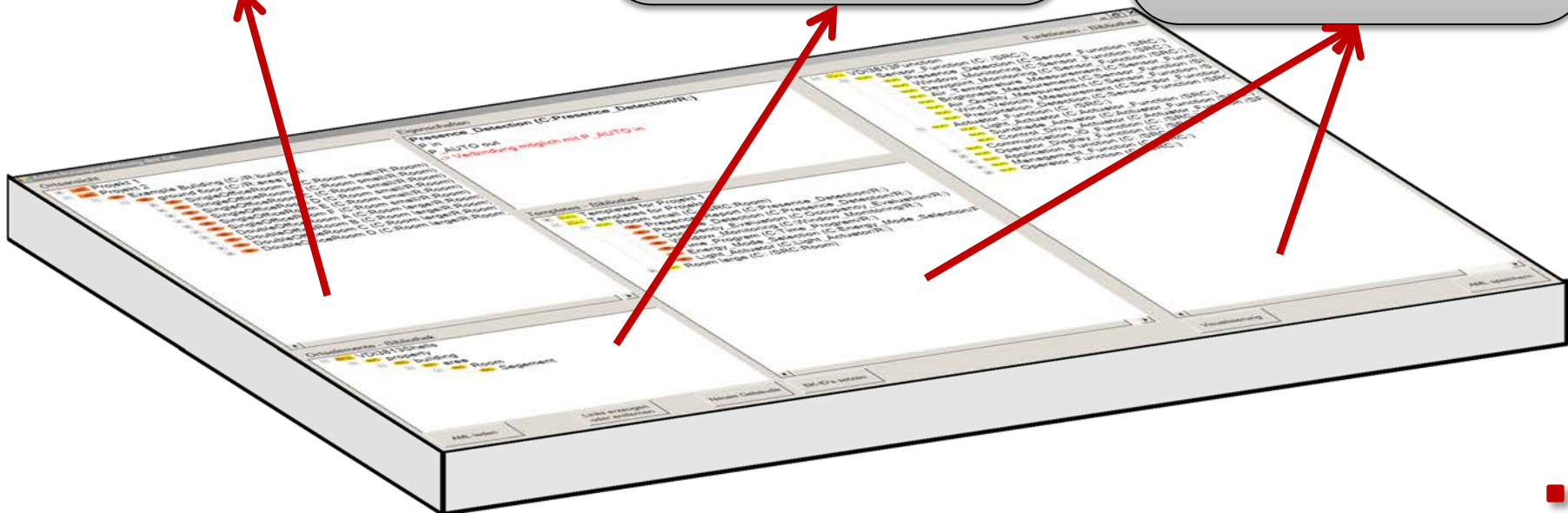
- complete BA system

RollClassLibrary

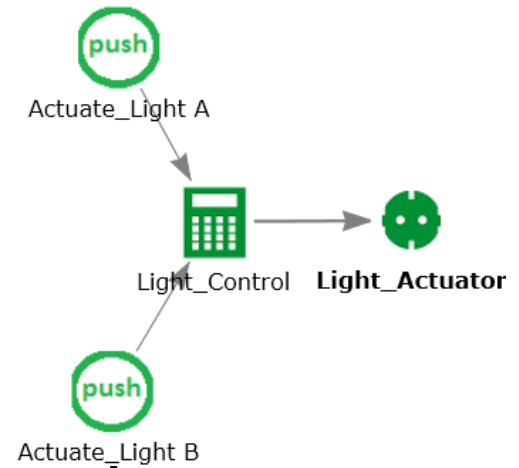
- library of local elements

SystemUnitClass-Library

- functions
- templates



- Visualisation of *InternalElements* with selectable Icons for *Roles* or *Classes*
- Visualisation of *InternalLinks*
- Change Management (new, change, delete, move)



Delta-Vergleich

InstanceHierarchy

Umsetzen

Lib		Details	ID
<input type="checkbox"/>		InstanceHierarchy	
<input type="checkbox"/> IH	NEW	Das InternalElement Actuate_Light wurde hinzugefügt.	eb1d622d-2d0f-433d-944d-1c5a4d898...
<input type="checkbox"/> IH	NEW	Das InternalElement Actuate_Light wurde hinzugefügt.	02b31591-c5bf-4307-b261-eeada88b0...
<input type="checkbox"/> IH	NEW	Das InternalElement Actuate_Light wurde hinzugefügt.	0f6efcd7-c40a-4325-97b0-de2f5f875347

- Update of *InternalElements* with changes from *SystemUnitClasses*

■ Fast instantiation of an amount of *InternalElements*

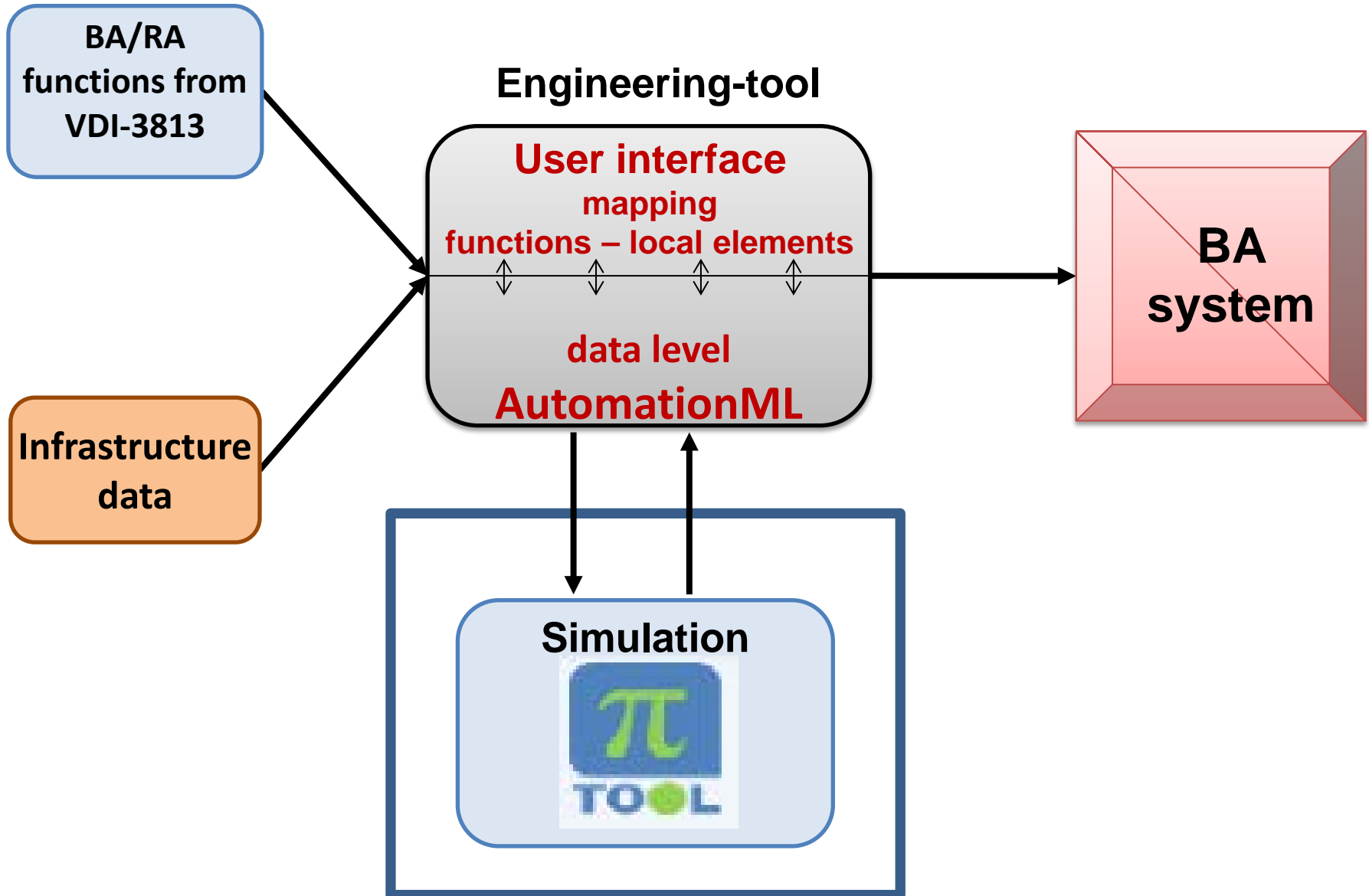
Neues Gebäude erstellen

Gebäudename Anzahl Bereiche

Bereich 1:
 besteht aus: Anzahl Typ

Bereich 2:
 besteht aus: Anzahl Typ

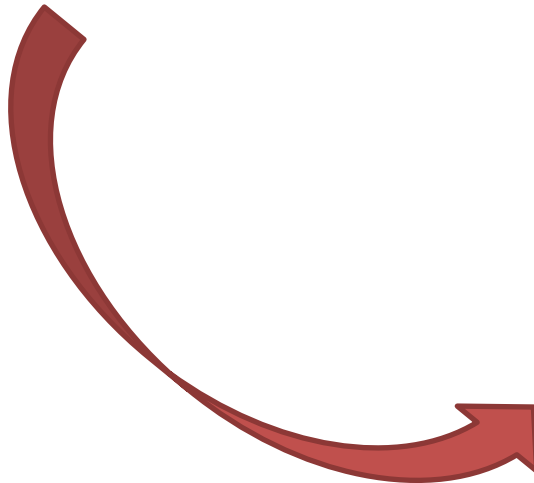
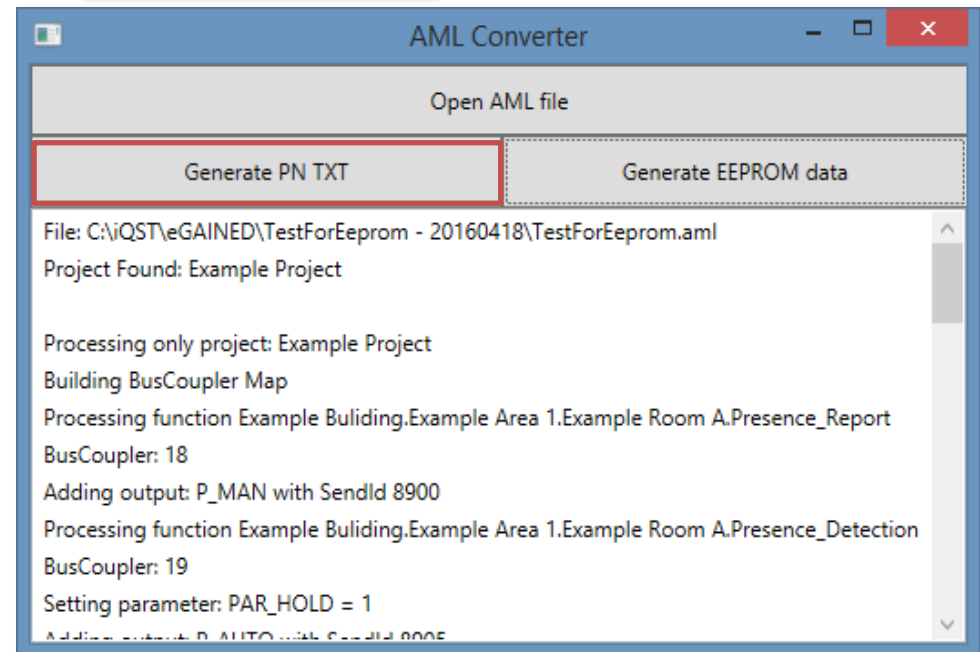
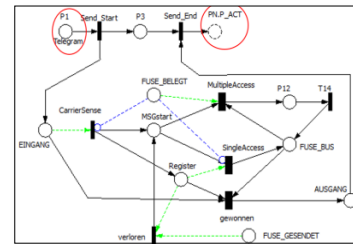
Bereich 3:
 besteht aus: Anzahl Typ



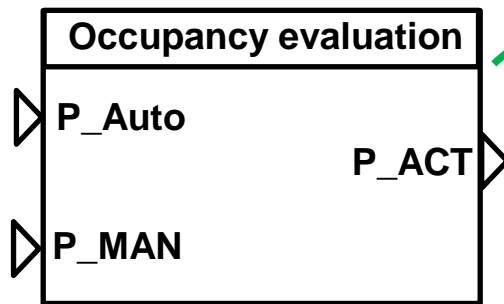
Export file:

- AutomationML
- Complete BA system
- Local hierarchy with all functions and links

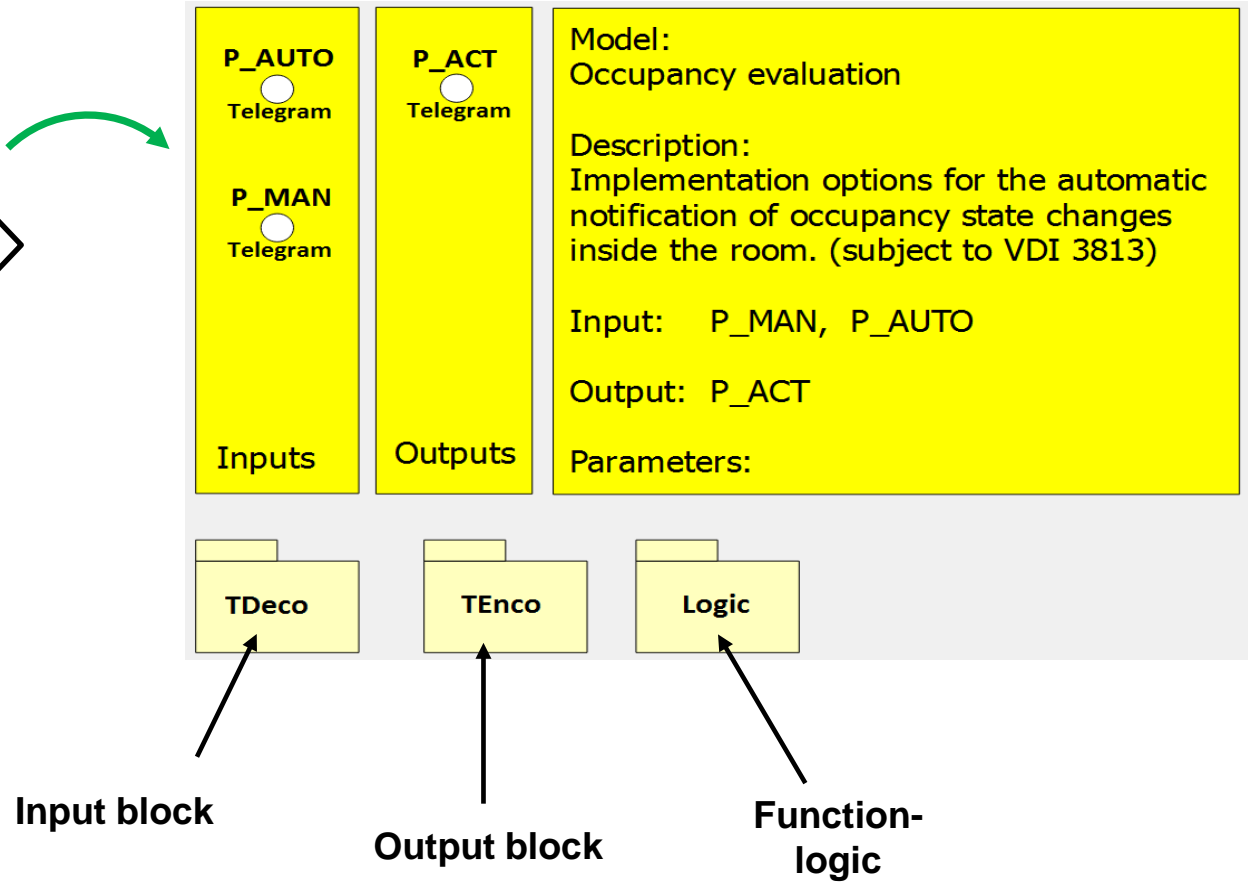
petrinet-simulation

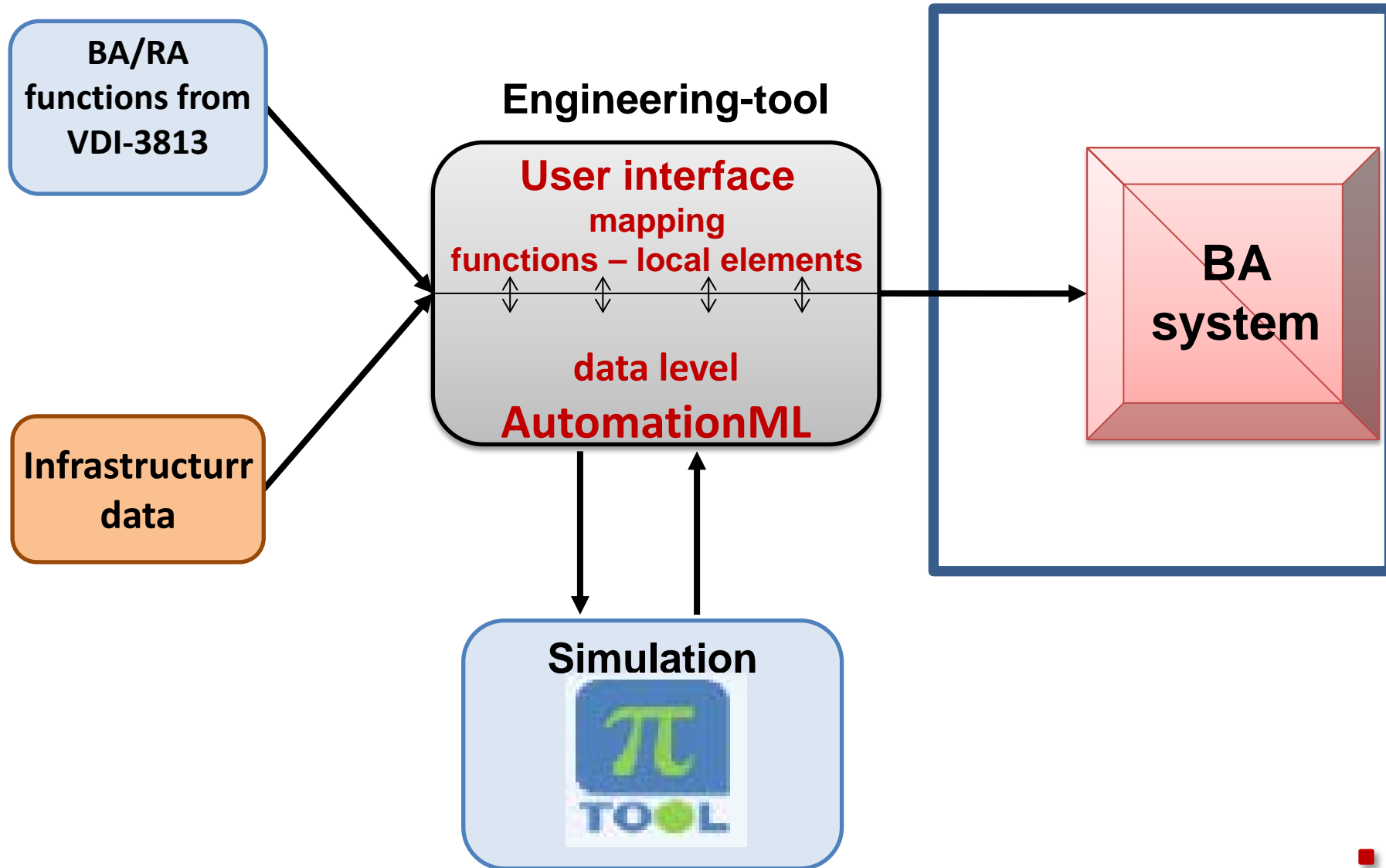


Function block from VDI-Guideline 3813



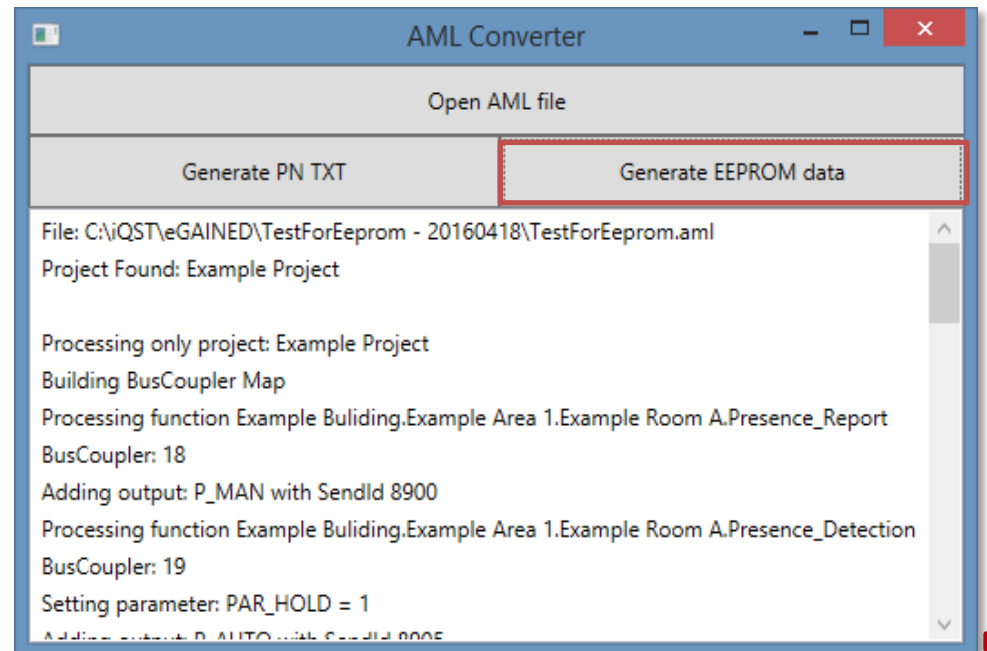
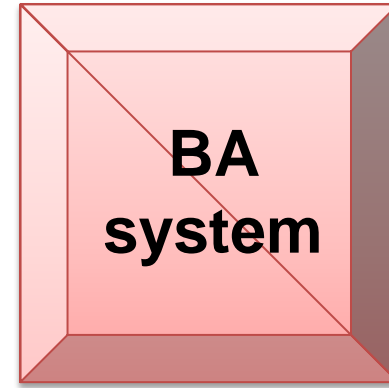
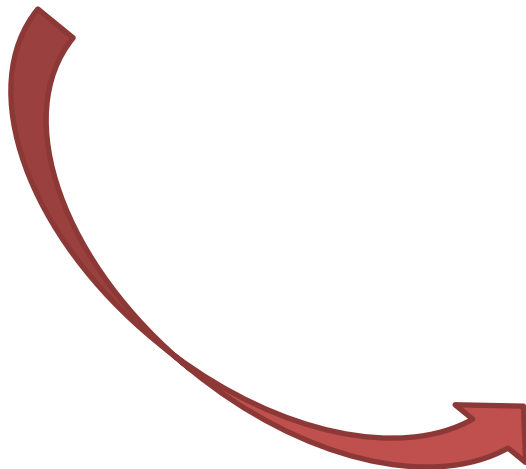
Overview template in the Petrinet-tool





Export file:

- AutomationML
- Complete BA system
- Local hierarchy with all functions and links



Systematic approach for modelling and analysis of BA systems

Basis for requirement engineering...

- Infrastructure data of the building
- Definition of functions according to VDI-Guideline 3813
- AutomationML for data exchange

Basis for automatic generation of petrinet ...

- Converter AutomationML to Petrinet-simulation
- Automatic parametrisation of real BA system

Analyse of petrinet for...

- Evaluation of the system specifications
- Evaluation of the performance

- Software is available: Mail to Engineering-tool@hsu-hh.de

Thank you for listening!

