<AutomationML/>

The Glue for Seamless Automation Engineering

Best Practice Recommendations
Modelling of Reference Designations

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Table of contents

Preface 3
1 Basics 3
1.1 Scope 3
1.2 References 3
2 Reference designations following IEC 81346 4
2.1 Basics 4
2.2 Modelling options 5
3 Modelling of reference designations 6
4 Practical examples 11

List of figures

Figure 1: Reference designations example 5
Figure 2: Semantic integration in AutomationML 6
Figure 3: Role library for reference designation integration in AutomationML 6
Figure 4: XML representation of role class library AutomationMLReferenceDesignationRoleClassLib 9
Figure 5: XML representation of interface class library AutomationMLReferenceDesignationInterfaceClassLib 10
Figure 6: Model based production system example 11
Figure 7: Model system example of reference designations as AutomationML Editor InstanceHierarchy 12
Figure 8: Turntable example of reference designations as XML text 17

List of tables

Table 1: Overview of AutomationML parts 3
Table 2: Examples of function, product, and location oriented reference designations 5
Table 3: Definition ContainsReferenceDesignation role class 7
Table 4: Definition functionOrientedReferenceDesignationMotherChildRelation interface class 9
Table 5: Definition productOrientedReferenceDesignationMotherChildRelation interface class 10
Table 6: Definition locationOrientedReferenceDesignationMotherChildRelation interface class 10

Preface

Technical systems are usually modular and/or hierarchically structured enabling the breakdown of the technical solution to individual solution components. This is valid for all technical systems independent of their nature or their character as product or production system.
During the life cycle of a technical system the individual components need to be identifiable as individual object and as object type. Therefore different identification capabilities are available.
One of the most recent identification methodologies of structured objects is codified within the IEC 81346- Industrial systems, installations and equipment and industrial products – Structuring principles and reference designations.
This best practice recommendation describes the integration of reference designations following IEC 81346-1:2009-07 within AutomationML based models of production systems.

1 Basics

The data exchange format AutomationML which is standardising in the IEC 62714 standard is a neutral, free, and XML-based data format. It has been developed in order to support the data exchange between engineering tools in a heterogeneous engineering tool landscape.

Due to the different aspects of AutomationML the IEC 62714 consists of different parts.

Table 1: Overview of AutomationML parts

Part	Title	Description
Part 1	Architecture and general requirements	This part specifies the general AutomationML architecture, the modelling of the engineering data, classes, instances, relations, references, hierarchies, basic AutomationML libraries and extended AutomationML concepts.
Part 2	Role class libraries	This part specifies additional AutomationML libraries.
Part 3	Geometry and kinematics	This part specifies the modelling of geometry and kinematics information.
Part 4	Logic	This part specifies the modelling of logics, sequencing, behaviour and control related information.
Whitepaper	Communication	This Whitepaper describes the modelling of Communication mechanisms in AutomationML
Whitepaper	AutomationML and eCl@ss integration	This Whitepaper describes the integration of eCl@ss in AutomationML

Further parts may be added in the future in order to e.g. interconnect further data standards to AutomationML.

1.1 Scope

This best practice recommendation proposes a modelling method for reference designations following IEC 81346-1:2009-07. It will describe the recommended use of role classes and attributes as well as the recommended structures to be considered within the instance hierarchy of an AutomationML project.

1.2 References

The following documents are referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Extensible Markup Language (XML) 1.0:2004, W3C Recommendation (available at <http://www.w3.org/TR/2004/REC-xml-20040204/>)

Whitepaper AutomationML Part 1 – AutomationML Architecture, May 2012

Whitepaper AutomationML Part 2 –AutomationML Role Libraries, May 2012

Whitepaper AutomationML Part 3 – AutomationML Geometry and Kinematics, May 2012

Whitepaper AutomationML Part 4 – AutomationML Logic Description, May 2012

Whitepaper AutomationML Part 5 – AutomationML Communication, September 2014

Whitepaper AutomationML Part 6 – AutomationML and eCl@ss Integration, November 2015

Industrial systems, installations and equipment and industrial products –Structuring principles and reference designations – Part 1: Basic rules (IEC 81346-1:2009-07)

2 Reference designations following IEC 81346

2.1 Basics

The IEC 81346-1:2009-07 postulates the existence of three main hierarchical structures within technical systems. These are the functional hierarchy, the product or component related hierarchy and the location hierarchy.

Each technical system follows the aim of transforming material, energetic, and/or information inputs to material, energetic, and/or information outputs. This transformation is considered as function of the technical system. The functional hierarchy named the different elements which are associated to the different parts of the function of the technical system. For example the function welding of a welding cell can be divided into the sub-functions material insertion, material clamping, welding, material unclamping, and welded material drawing.

Each technical system consists of components purchased by different vendors. The product or component related hierarchy represents the integration structure of the different purchased objects within the technical system.

Each technical system follows a local structure defining the geographical / physical position of its elements. The location hierarchy represents the local address of a component of the technical system.

An example of these three structures is depicted in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

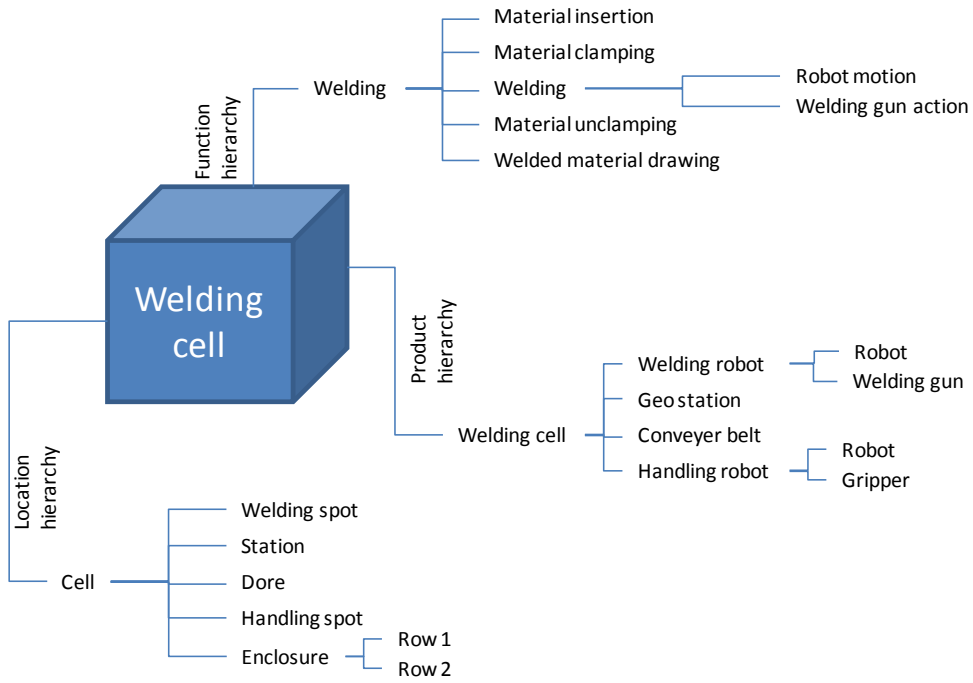

Figure 1: Reference designations example

To represent the hierarchies and to enable the identification of the different components within the hierarchies the IEC 81346-1:2009-07 defines reference designations. Each reference designation is structured as a layered identification system were on each layer code letters, code letter with numbers or numbers shall be used to identify the components of the individual layers. The different layers are separated by different marks with the following semantics.

= is used as indicator for function oriented reference designations;

– is used as indicator for product oriented reference designations;

+ is used as indicator for location oriented reference designations;

is used as indicator for further aspects of objects.

Examples of function, product, and location oriented aspects are given in the following table following the IEC 81346-1:2009-07.

Table 2: Examples of function, product, and location oriented reference designations

Function oriented reference designation	Product oriented reference designation	Location oriented reference designation
=B1	-B1	+G1
=EB	-Relay	+RU
=123	-561	+101
=KK12	-BT12	+UC101

2.2 Modelling options

To each object within a technical system the different reference designations can be assigned completely or partially following the application case.

Within a technical system develop and installed as special solution for a production system (for example) each object can carry the complete reference designation indicating all upper layers of the object and the own identification. This referenced designation is given completely.

In contrast in a component library the reference designation is incomplete as the upper layers are unknown. But for each part of the component local (or partial) reference designations can be given which can be completed in the case of component integration within a final solution.

Hence, the modelling of reference designations within AutomationML requires the distinction of global (or complete) reference designations and local (or partial) reference designations. In the case of local reference designations the mother – child relation of objects (if existing) need to be stored additionally to enable the determination of the complete reference designation out of a set of local ones.

3 Modelling of reference designations

Within Whitepaper AutomationML Part 6 – AutomationML and eCl@ss Integration from November 2015 a way to integrate the semantic of catalogue elements defined in a classification catalogue like eCl@ss into AutomationML is presented. It applies to semantic integration technologies.

On the one hand the semantic of Attributes is modelled by the RefSemantic sub-attribute. On the other hand the semantic of objects (InternalElements) is modelled by RoleClasses assigned to by the attributes RoleRequirement and/or SupportedRoleClass as given in the following Figure.

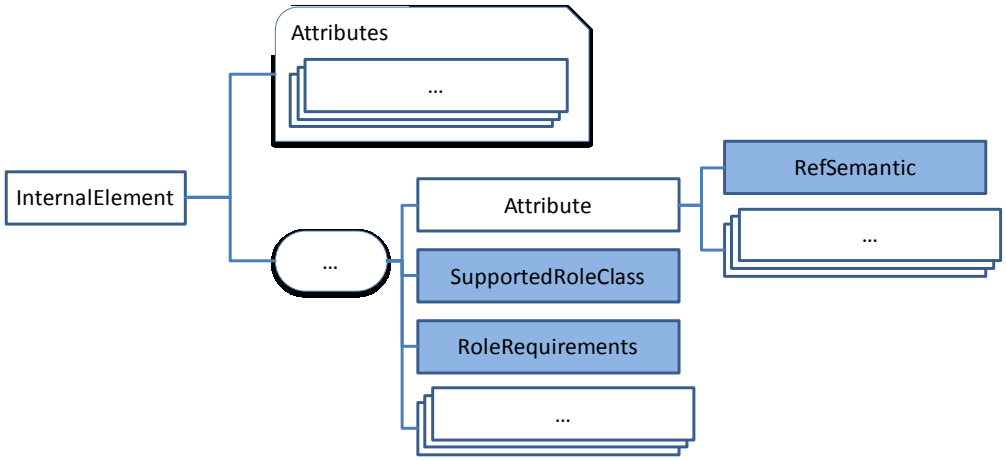

Figure 2: Semantic integration in AutomationML

Both techniques shall be applied too for semantically modelling of reference designations.

To uniquely express, that an object in AutomationML (an InternalElement) contains a reference designation it shall have the following role (or a role derived from this role) as RoleRequirement or SupportedRoleClass.

In addition this role defined attributes (named in Table 3) to store the global (or complete) reference designations and local (or partial) reference designations for the function-oriented, the product-oriented, and the location oriented structure.

The following figure represents the role class ContainsReferenceDesignation defined in the AutomationMLReferenceDesignationRoleClassLib.

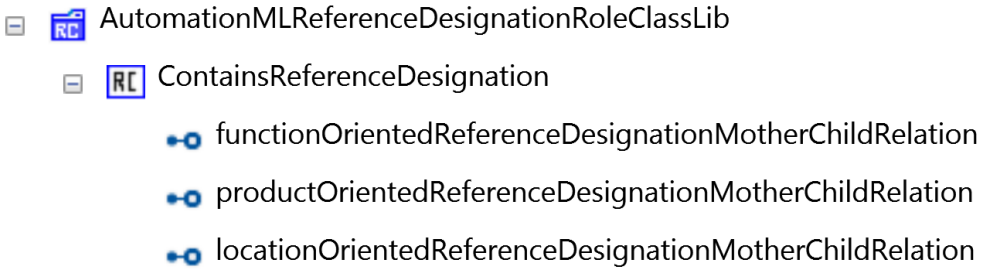

Figure 3: Role library for reference designation integration in AutomationML

The role class ContainsReferenceDesignation is defined in Table 3.

Table 3: Definition ContainsReferenceDesignation role class

Role class name	ContainsReferenceDesignation	
Description	The role class “ContainsReferenceDesignation” shall be used in order to identify a modelling element as to be able to contain a referenced designation following IEC 81346-1:2009-07.	
Parent Class	AutomationMLBaseRole	
Attributes	“functionOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “functionOrientedReferenceDesignation” shall represent the function oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.3 - Function-oriented structure” to enable its identification if the name is changed.
	“localfunctionOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “localfunctionOrientedReferenceDesignation” shall represent the single hierarchy level related part of the function oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.3 –Function-oriented structure (local)” to enable its identification if the name is changed.
	“productOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “productOrientedReferenceDesignation” shall represent the product oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.4 - Product-oriented structure” to enable its identification if the name is changed.
	“localproductOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “localproductOrientedReferenceDesignation” shall represent the single hierarchy level related part of the product oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.4 - Product-oriented structure (local)” to enable its identification if the name is changed.

	“locationOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “productOrientedReferenceDesignation” shall represent the product oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.5 - Location-oriented structure” to enable its identification if the name is changed.
	“locallocationOrientedReferenceDesignation” (AttributeDataType=”xs:string”)	The attribute “localproductOrientedReferenceDesignation” shall represent the single hierarchy level related part of the product oriented reference designation of the object. The attribute name can be changed if required. The attribute shall contain in the sub-attribute refSemantic the value “IEC 81346-1:2009-07#5.5 - Location-oriented structure (local)” to enable its identification if the name is changed.

Note: Each InternalElement or SystemUnitClass referencing the role class ContainsReferenceDesignation as supported role class or role requirement shall contain at least one of the 6 attributes defined in Table 3. The other 5 attributes are than optional.

Figure 5 represents the XML definition of the role class library AutomationMLReferenceDesignation RoleClassLib and their involved role class ContainsReferenceDesignation.

```
<RoleClassLib Name="AutomationMLReferenceDesignationRoleClassLib">
    <Version>1.0.0</Version>
    <RoleClass Name="ContainsReferenceDesignation" RefBaseClassPath="AutomationMLBaseRoleClassLib/
                                                                     AutomationMLBaseRole">
        <Attribute Name="functionOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Function oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-oriented structure" />
        </Attribute>
        <Attribute Name="localfunctionOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Local part of the function oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-oriented structure (local)" />
        </Attribute>
        <Attribute Name="productOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Product oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.4 - Product-oriented structure" />
        </Attribute>
        <Attribute Name="localproductOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Local part of the product oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.4 - Product-oriented structure (local)" />
        </Attribute>
        <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Location oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure" />
        </Attribute>
        <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Local part of the location oriented reference designation following IEC 81346.</Description>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure (local)" />
        </Attribute>
        <ExternalInterface Name="functionOrientedReferenceDesignationMotherChildRelation"
                           RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                             function OrientedReferenceDesignationMotherChildRelation"
                           ID="e8094caa-7ad6-4a7e-b882-840ccb7271d6">
            <Attribute Name="Direction" AttributeDataType="xs:string" />
        </ExternalInterface>
        <ExternalInterface Name="productOrientedReferenceDesignationMotherChildRelation"
                           RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                             productOrientedReferenceDesignationMotherChildRelation"
                           ID="e53c7ff7-4f29-4010-af9d-fa18e94ea2b4">
            <Attribute Name="Direction" AttributeDataType="xs:string" />
        </ExternalInterface>
        <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation"
                           RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                             locationOrientedReferenceDesignationMotherChildRelation"
                           ID="093f4d3f-85a2-4027-a1c6-faee864e6ea6">
            <Attribute Name="Direction" AttributeDataType="xs:string" />
        </ExternalInterface>
    </RoleClass>
</RoleClassLib>
```

Figure 4: XML representation of role class library AutomationMLReferenceDesignationRoleClassLib

To express the dependencies of objects related to the mother and child relation within a reference designation interface classes for the function-oriented, the product-oriented, and the location oriented structure are defined in Tables 4 – 6.

Table 4: Definition functionOrientedReferenceDesignationMotherChildRelation interface class

Interface class name	functionOrientedReferenceDesignationMotherChildRelation	
Description	The interface class “functionOrientedReferenceDesignationMotherChildRelation” shall be used in order to specify the mother and child relation of objects related to the local function oriented referenced designation following IEC 81346-1:2009-07.	
Parent Class	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order	
Attributes	“Direction” (AttributeDataType=”xs:string”)	This attribute is derived from the mother class. It shall contain the value in to represent the mother side of the mother child relation and out in to represent the child side of the mother child relation.

Table 5: Definition productOrientedReferenceDesignationMotherChildRelation interface class

Interface class name	productOrientedReferenceDesignationMotherChildRelation	
Description	The interface class "productOrientedReferenceDesignationMotherChildRelation" shall be used in order to specify the mother and child relation of objects related to the local product oriented referenced designation following IEC 81346-1:2009-07.	
Parent Class	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order	
Attributes	"Direction" (AttributeDataType="xs:string")	This attribute is derived from the mother class. It shall contain the value in to represent the mother side of the mother child relation and out in to represent the child side of the mother child relation.

Table 6: Definition locationOrientedReferenceDesignationMotherChildRelation interface class

Interface class name	locationOrientedReferenceDesignationMotherChildRelation	
Description	The interface class "locationOrientedReferenceDesignationMotherChildRelation" shall be used in order to specify the mother and child relation of objects related to the local location oriented referenced designation following IEC 81346-1:2009-07.	
Parent Class	AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order	
Attributes	"Direction" (AttributeDataType="xs:string")	This attribute is derived from the mother class. It shall contain the value in to represent the mother side of the mother child relation and out in to represent the child side of the mother child relation.

Note: Each InternalElement or SystemUnitClass referencing the role class ContainsReferenceDesignation as supported role class or role requirement and containing the attribute localfunctionOrientedReferenceDesignation shall also contain at least one interface of the interface class type functionOrientedReferenceDesignationMotherChildRelation.

Note: Each InternalElement or SystemUnitClass referencing the role class ContainsReferenceDesignation as supported role class or role requirement and containing the attribute localproductOrientedReferenceDesignation shall also contain at least one interface of the interface class type productOrientedReferenceDesignationMotherChildRelation.

Note: Each InternalElement or SystemUnitClass referencing the role class ContainsReferenceDesignation as supported role class or role requirement and containing the attribute locallocationOrientedReferenceDesignation shall also contain at least one interface of the interface class type locationOrientedReferenceDesignationMotherChildRelation.

Figure 5 represents the XML definition of the interface class library AutomationMLReferenceDesignationInterfaceClassLib and their involved interface classes.

```
<InterfaceClassLib Name="AutomationMLReferenceDesignationInterfaceClassLib">
      <Version>1.0.0</Version>
      <InterfaceClass Name="functionOrientedReferenceDesignationMotherChildRelation"
                      RefBaseClassPath="AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order" />
      <InterfaceClass Name="productOrientedReferenceDesignationMotherChildRelation"
                      RefBaseClassPath="AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order" />
      <InterfaceClass Name="locationOrientedReferenceDesignationMotherChildRelation"
                      RefBaseClassPath="AutomationMLInterfaceClassLib/AutomationMLBaseInterface/Order" />
</InterfaceClassLib>
```

Figure 5: XML representation of interface class library AutomationMLReferenceDesignationInterfaceClassLib

4 Practical examples

As an example for the modelling of reference designations a model based manufacturing system located at Otto-v.-Guericke University Magdeburg is used. This system represents a parcel sorting system with parcel storage, conveyer belt, two sorting pushers and three deposit places as depicted in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

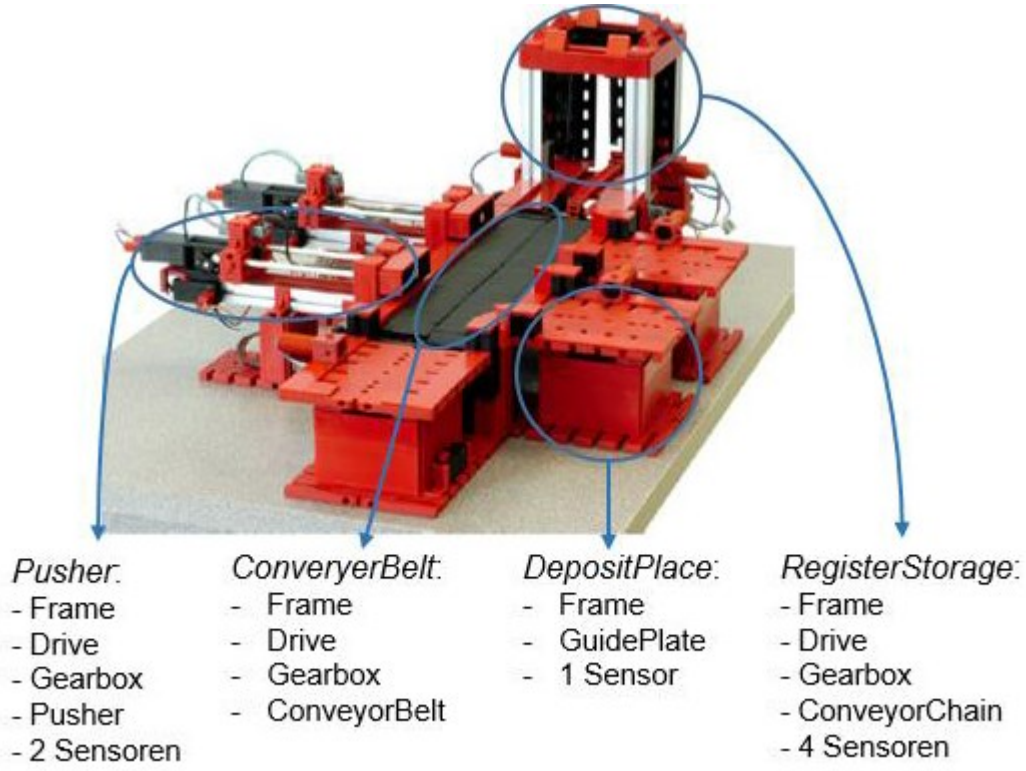

Figure 6: Model based production system example

One element within this manufacturing system is the deposit place one with its involved optical sensor. For this example system the location oriented structure with the location oriented reference designations is +OvGU+B10+R445+P1+SP2+U5+D3 which is equivalent to

University
→ Building 10
→ Room 445
→ Production system 1/ Sorting line
→ System part 2 / Baseplate
→ Unit 5 / Deposit place 1
→ Device 3 / Reflection light barrier.

The function oriented structure with the function oriented reference designations is =Sor1=Pu1=S4 which is equivalent to

Sorting line
→ Pusher 1
→ Sensor 4 / Reflection light barrier

The product oriented reference designation is only assigned to the complete sorting line with -U1-H10-F5-R445-CP2.

The following figure represents the modelling of global (complete) and local (partial) function, product and location oriented reference designation of the example system including internal links between interfaces and attributes for the model elements SortingLine, Baseline, and Pusher1.

Figure 7: Model system example of reference designations as AutomationML Editor InstanceHierarchy

The following figure represents the complete XML structure of the instance hierarchy of the example model.

```
<InstanceHierarchy Name="InstanceHierarchy_ExampleReferenceDesignation">
      <Version>1.0.0</Version>
      <InternalElement ID="952856af-4a44-42f7-9c1f-fb879d71c811" Name="Otto-von-Guericke University Magdeburg">
            <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
                  <Description>Location oriented reference designation following IEC 81346.</Description>
                  <Value>+OvGU</Value>
                  <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure" />
            </Attribute>
            <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
                  <Description>Local part of the location oriented reference designation following IEC 81346.</Description>
                  <Value>+OvGU</Value>
                  <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure (local)" />
            </Attribute>
            <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                               RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/locationOriented
                                                 ReferenceDesignationMotherChildRelation"
                               ID="fccaa83d-772b-4c96-9a4f-83706fc098e9">
                  <Attribute Name="Direction" AttributeDataType="xs:string">
                        <Value>in</Value>
                  </Attribute>
            </ExternalInterface>
            <InternalElement ID="c13c047c-10d5-4714-898d-f84b0b850c08" Name="Building10">
                  <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
                        <Description>Location oriented reference designation following IEC 81346.</Description>
                        <Value>+OvGU+B10</Value>
                        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure" />
                  </Attribute>
                  <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
                        <Description>Local part of the location oriented reference designation following IEC 81346.</Description>
                        <Value>+B10</Value>
                        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure
                                                                 (local)" />
                  </Attribute>
                  <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                                     RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
```

```
                                                    locationOrientedReferenceDesignationMotherChildRelation"
                        ID="090c0809-6a32-4d88-aa46-043cf8fd232c">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>out</Value>
            </Attribute>
        </ExternalInterface>
        <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                        RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                          locationOrientedReferenceDesignationMotherChildRelation"
                        ID="cbcb97cc-3bbf-4a9d-9fb3-42c56ba92609">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>in</Value>
            </Attribute>
        </ExternalInterface>
        <InternalElement ID="4cb0fe79-3a69-40e6-a692-3c8b052f2d8a" Name="Room445">
            <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
                <Description>Location oriented reference designation following IEC 81346.</Description>
                <Value>+OvGU+B10+R445</Value>
                <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented
                                                         structure" />
            </Attribute>
            <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
                <Description>Local part of the location oriented reference designation following IEC
                             81346.</Description>
                <Value>+R445</Value>
                <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented structure
                                                         (local)" />
            </Attribute>
            <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                            RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                              locationOrientedReferenceDesignationMotherChildRelation"
                            ID="c642b6aa-b262-4564-861e-8f20fa17bfaa">
                <Attribute Name="Direction" AttributeDataType="xs:string">
                    <Value>out</Value>
                </Attribute>
            </ExternalInterface>
            <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                            RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                              locationOrientedReferenceDesignationMotherChildRelation"
                            ID="0f983f3c-66f0-4433-9a3d-1c177fbc8b74">
                <Attribute Name="Direction" AttributeDataType="xs:string">
                    <Value>in</Value>
                </Attribute>
            </ExternalInterface>
            <InternalElement ID="e7fee487-df36-4aeb-880f-134af4616f42" Name="SortingLine">
                <Attribute Name="functionOrientedReferenceDesignation" AttributeDataType="xs:string">
                    <Description>Function oriented reference designation following IEC 81346.</Description>
                    <Value>=Sor1</Value>
                    <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-oriented
                                                             structure" />
                </Attribute>
                <Attribute Name="productOrientedReferenceDesignation" AttributeDataType="xs:string">
                    <Description>Product oriented reference designation following IEC 81346.</Description>
                    <Value>-U1-H10-F5-R445-CP2</Value>
                    <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.4 - Product-oriented
                                                             structure" />
                </Attribute>
                <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
                    <Description>Location oriented reference designation following IEC 81346.</Description>
                    <Value>+OvGU+B10+R445+P1</Value>
                    <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented
                                                             structure" />
                </Attribute>
                <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
                    <Description>Local part of the location oriented reference designation following IEC
                                 81346.</Description>
                    <Value>+P1</Value>
                    <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-oriented
                                                             structure (local)" />
                </Attribute>
                <Attribute Name="localfunctionOrientedReferenceDesignation" AttributeDataType="xs:string">
                    <Description>Local part of the function oriented reference designation following IEC
                                 81346.</Description>
```

```
        <Value>=Sor1</Value>
        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-oriented
                                                 structure (local)" />
</Attribute>
<ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                   RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                     locationOrientedReferenceDesignationMotherChildRelation"
                   ID="5f00c457-496a-4356-952b-6245cbe5b381">
        <Attribute Name="Direction" AttributeDataType="xs:string">
            <Value>out</Value>
        </Attribute>
</ExternalInterface>
<ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                   RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                     locationOrientedReferenceDesignationMotherChildRelation"
                   ID="58206fe8-d26f-415e-80e0-e2bad399d657">
        <Attribute Name="Direction" AttributeDataType="xs:string">
            <Value>in</Value>
        </Attribute>
</ExternalInterface>
<ExternalInterface Name="functionOrientedReferenceDesignationMotherChildRelation_Mother"
                   RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                     functionOrientedReferenceDesignationMotherChildRelation"
                   ID="be6a913a-f9b6-4464-a905-1e2236d3a531">
        <Attribute Name="Direction" AttributeDataType="xs:string">
            <Value>in</Value>
        </Attribute>
</ExternalInterface>
<InternalElement ID="ea4af221-65cf-474c-ac32-cf9fa7060d9f" Name="Baseline">
        <Attribute Name="locationOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Location oriented reference designation following IEC
                         81346.</Description>
            <Value>+OvGU+B10+R445+P1+SP2</Value>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-
                                                     oriented structure" />
        </Attribute>
        <Attribute Name="locallocationOrientedReferenceDesignation" AttributeDataType="xs:string">
            <Description>Local part of the location oriented reference designation following IEC
                         81346.</Description>
            <Value>+SP2</Value>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 - Location-
                                                     oriented structure (local)" />
        </Attribute>
        <ExternalInterface Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                           RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                             locationOrientedReferenceDesignationMotherChildRelation"
                           ID="cfb38cba-20a8-4048-8c11-ed4e053cfb40">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>in</Value>
            </Attribute>
        </ExternalInterface>
        <ExternalInterface
                           Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                           RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                             locationOrientedReferenceDesignationMotherChildRelation"
                           ID="8ab4eb8d-7204-40c2-8410-cd86cc216cae">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>out</Value>
            </Attribute>
        </ExternalInterface>
        <InternalElement Name="Pusher1" ID="6bb96297-ff2b-4e5f-b266-780bcf993074">
            <Attribute Name="functionOrientedReferenceDesignation"
                       AttributeDataType="xs:string">
                <Description>Function oriented reference designation following IEC
                             81346.</Description>
                <Value>=Sor1=Pu1</Value>
                <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-
                                                         oriented structure" />
            </Attribute>
            <Attribute Name="localfunctionOrientedReferenceDesignation"
                       AttributeDataType="xs:string">
                <Description>Local part of the function oriented reference designation following
                             IEC 81346.</Description>
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            <Value>=Pu1</Value>
            <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3 - Function-
                                                    oriented structure (local)" />
        </Attribute>
        <ExternalInterface
                Name="functionOrientedReferenceDesignationMotherChildRelation_Child"
                RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                        functionOrientedReferenceDesignationMotherChildRelation"
                ID="061c7bbd-32ed-49bb-a58b-456ab281ed42">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>out</Value>
            </Attribute>
        </ExternalInterface>
        <ExternalInterface
                Name="functionOrientedReferenceDesignationMotherChildRelation_Mother"
                RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                        functionOrientedReferenceDesignationMotherChildRelation"
                ID="2b8f720f-cccb-45c7-8f86-8cc8c64b4ea4">
            <Attribute Name="Direction" AttributeDataType="xs:string">
                <Value>in</Value>
            </Attribute>
        </ExternalInterface>
        <InternalElement ID="dd2020d6-77fd-49dd-8364-cc85ec236b6b"
                Name="Composed_DepositPlace1">
            <Attribute Name="locationOrientedReferenceDesignation"
                    AttributeDataType="xs:string">
                <Description>Location oriented reference designation following IEC
                        81346.</Description>
                <Value>+OvGU+B10+R445+P1+SP2+U5</Value>
                <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 –
                                                    Location-oriented structure" />
            </Attribute>
            <Attribute Name="locallocationOrientedReferenceDesignation"
                    AttributeDataType="xs:string">
                <Description>Local part of the location oriented reference designation
                        following IEC 81346.</Description>
                <Value>+U5</Value>
                <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5 –
                                                    Location-oriented structure (local)" />
            </Attribute>
            <ExternalInterface
                    Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                    RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                            locationOrientedReferenceDesignationMotherChildRelation"
                    ID="2e6334c1-238f-4271-8994-26d1417fb99e">
                <Attribute Name="Direction" AttributeDataType="xs:string">
                    <Value>out</Value>
                </Attribute>
            </ExternalInterface>
            <ExternalInterface
                    Name="locationOrientedReferenceDesignationMotherChildRelation_Mother"
                    RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                            locationOrientedReferenceDesignationMotherChildRelation"
                    ID="ee868b55-32b0-4729-af1a-da0175654e39">
                <Attribute Name="Direction" AttributeDataType="xs:string">
                    <Value>in</Value>
                </Attribute>
            </ExternalInterface>
            <InternalElement Name="Reflection light barrier"
                    ID="e2739382-a271-4027-9799-ff3b40e0a2cb">
                <Attribute Name="functionOrientedReferenceDesignation"
                        AttributeDataType="xs:string">
                    <Description>Function oriented reference designation following IEC
                            81346.</Description>
                    <Value>=Sor1=Pu1=S4</Value>
                    <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3
                                                    - Function-oriented structure" />
                </Attribute>
                <Attribute Name="localfunctionOrientedReferenceDesignation"
                        AttributeDataType="xs:string">
                    <Description>Local part of the function oriented reference designation
                            following IEC 81346.</Description>
                    <Value>=S4</Value>
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                        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.3
                                                        - Function-oriented structure" />
                    </Attribute>
                    <Attribute Name="locationOrientedReferenceDesignation"
                            AttributeDataType="xs:string">
                        <Description>Location oriented reference designation following IEC
                                81346.</Description>
                        <Value>+OvGU+B10+R445+P1+SP2+U5+D3</Value>
                        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5
                                                        - Location-oriented structure (local)" />
                    </Attribute>
                    <Attribute Name="locallocationOrientedReferenceDesignation"
                            AttributeDataType="xs:string">
                        <Description>Local part of the location oriented reference designation
                                following IEC 81346.</Description>
                        <Value>+D3</Value>
                        <RefSemantic CorrespondingAttributePath="IEC 81346-1:2009-07#5.5
                                                        - Location-oriented structure (local)" />
                    </Attribute>
                    <ExternalInterface
                      Name="locationOrientedReferenceDesignationMotherChildRelation_Child"
                      RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                locationOrientedReferenceDesignationMotherChildRelation"
                      ID="bf8836db-bf55-4af9-abee-b65c1865d827">
                        <Attribute Name="Direction" AttributeDataType="xs:string">
                            <Value>out</Value>
                        </Attribute>
                    </ExternalInterface>
                    <ExternalInterface
                      Name="functionOrientedReferenceDesignationMotherChildRelation_Child"
                      RefBaseClassPath="AutomationMLReferenceDesignationInterfaceClassLib/
                                functionOrientedReferenceDesignationMotherChildRelation"
                      ID="cc67db33-5b98-4d6b-a086-59e926eefad7">
                        <Attribute Name="Direction" AttributeDataType="xs:string">
                            <Value>out</Value>
                        </Attribute>
                    </ExternalInterface>
                    <RoleRequirements
                      RefBaseRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                _implicitReference/ContainsReferenceDesignation" />
                </InternalElement>
                <SupportedRoleClass
                        RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                _implicitReference/ContainsReferenceDesignation" />
                <InternalLink Name="Link7"
                        RefPartnerSideA="e2739382-a271-4027-9799-ff3b40e0a2cb:
                          locationOrientedReferenceDesignationMotherChildRelation_Child"
                        RefPartnerSideB="dd2020d6-77fd-49dd-8364-cc85ec236b6b:
                          locationOrientedReferenceDesignationMotherChildRelation_Mother" />
                <RoleRequirements
                        RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/Unit" />
            </InternalElement>
            <SupportedRoleClass
                        RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                _implicitReference/ContainsReferenceDesignation" />
            <InternalLink Name="Link8"
                        RefPartnerSideA="e2739382-a271-4027-9799-ff3b40e0a2cb:
                          functionOrientedReferenceDesignationMotherChildRelation_Child"
                        RefPartnerSideB="6bb96297-ff2b-4e5f-b266-780bcf993074:
                          functionOrientedReferenceDesignationMotherChildRelation_Mother" />
            <RoleRequirements
                        RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/Unit" />
        </InternalElement>
        <SupportedRoleClass
                        RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                _implicitReference/ContainsReferenceDesignation" />
        <InternalLink Name="Link6"
                        RefPartnerSideA="dd2020d6-77fd-49dd-8364-cc85ec236b6b:
                          locationOrientedReferenceDesignationMotherChildRelation_Child"
                        RefPartnerSideB="ea4af221-65cf-474c-ac32-cf9fa7060d9f:
                          locationOrientedReferenceDesignationMotherChildRelation_Mother" />
        <RoleRequirements
                        RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/WorkCell"/>
```

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                    </InternalElement>
                    <SupportedRoleClass
                            RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                    _implicitReference/ContainsReferenceDesignation" />
                    <InternalLink Name="Link4"
                            RefPartnerSideA="ea4af221-65cf-474c-ac32-cf9fa7060d9f:
                                    locationOrientedReferenceDesignationMotherChildRelation_Child"
                            RefPartnerSideB="e7fee487-df36-4aeb-880f-134af4616f42:
                                    locationOrientedReferenceDesignationMotherChildRelation_Mother" />
                    <InternalLink Name="Link5"
                            RefPartnerSideA="6bb96297-ff2b-4e5f-b266-780bcf993074:
                                    functionOrientedReferenceDesignationMotherChildRelation_Child"
                            RefPartnerSideB="e7fee487-df36-4aeb-880f-134af4616f42:
                                    functionOrientedReferenceDesignationMotherChildRelation_Mother" />
                    <RoleRequirements
                            RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/ProductionLine" />
                </InternalElement>
                <SupportedRoleClass
                            RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                    _implicitReference/ContainsReferenceDesignation" />
                <InternalLink Name="Link3"
                            RefPartnerSideA="e7fee487-df36-4aeb-880f-134af4616f42:
                                    locationOrientedReferenceDesignationMotherChildRelation_Child"
                            RefPartnerSideB="4cb0fe79-3a69-40e6-a692-3c8b052f2d8a:
                                    locationOrientedReferenceDesignationMotherChildRelation_Mother" />
                <RoleRequirements RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/Area" />
            </InternalElement>
            <SupportedRoleClass
                            RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                                    _implicitReference/ContainsReferenceDesignation" />
            <InternalLink Name="Link2"
                        RefPartnerSideA="4cb0fe79-3a69-40e6-a692-3c8b052f2d8a:
                                locationOrientedReferenceDesignationMotherChildRelation_Child"
                        RefPartnerSideB="c13c047c-10d5-4714-898d-f84b0b850c08:
                                locationOrientedReferenceDesignationMotherChildRelation_Mother" />
            <RoleRequirements RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/Site" />
        </InternalElement>
        <SupportedRoleClass
                    RefRoleClassPath="AutomationMLReferenceDesignationRoleClassLib
                            _implicitReference/ContainsReferenceDesignation" />
        <InternalLink Name="Link1"
                    RefPartnerSideA="c13c047c-10d5-4714-898d-f84b0b850c08:
                            locationOrientedReferenceDesignationMotherChildRelation_Child"
                    RefPartnerSideB="952856af-4a44-42f7-9c1f-fb879d71c811:
                            locationOrientedReferenceDesignationMotherChildRelation_Mother" />
        <RoleRequirements RefBaseRoleClassPath="AutomationMLExtendedRoleClassLib/Enterprise" />
    </InternalElement>
</InstanceHierarchy>
```

Figure 8: Turntable example of reference designations as XML text