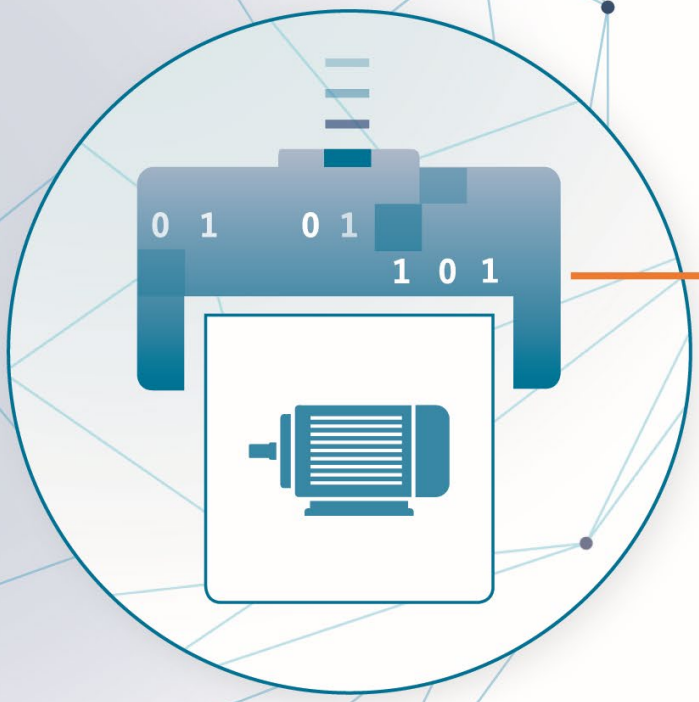
SPECIFICATION

Submodel Templates of the Asset Administration Shell



Submodel
TECHNICAL DATA

- Max. Rotation Speed = 5000 [1/min]
- Max. Torque = 200 [Nm]
- Cooling Type = BAB657

Submodel
OPERATIONAL DATA

- Rotation Speed = 4370 [1/min]
- Torque = 117.4 [Nm]

Submodel
DOCUMENTATION

- Title = Operating Manual
- Digital File PDF → /aasx/OperatingManual.PDF
- Document Class ID = 03-02

Handover information for engineering authoring systems (v0.8)

in cooperation with

PLATTFORM INDUSTRIE4.0

VDMA Fluid Power

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Contents

1 General

1.1 About this document

This document is a part of a specification series. Each part specifies the contents of a Submodel template for the Asset Administration Shell (AAS). The AAS is described in [1], [2], [3] and [6]. First exemplary Submodel contents were described in [4], while the actual format of this document was derived by the "Administration Shell in Practice" [5]. The format aims to be very concise, giving only minimal necessary information for applying a Submodel template, while leaving deeper descriptions and specification of concepts, structures and mapping to the respective documents [1] to [6]. Common terms and abbreviations can be found in [8].

This document is actually a proposal for such a Submodel template specification. It has been jointly worked out by experts of the VDMA working group "digitalization for fluid power systems" together with members of the ECLASS segment group 51, based on collection used experience of industrial users.

The target audience of the specification are developers and editors of technical documentation and manufacturer information, which are describing assets in smart manufacturing by means of the Asset Administration Shell (AAS) and therefore need to create a Submodel instance with a hierarchy of SubmodelElements. This document especially details on the question, which SubmodelElements with which semantic identification shall be used for this purpose.

1.2 Scope of the Submodel

This Submodel template aims at interoperable provision of information models for engineering authoring systems for the handover of industrial components. These industrial components are typically provided by manufacturers and suppliers, including dealers, and used by industrial users, e.g. original equipment manufacturers (OEMs), system integrators and producing enterprises (industrial end users). Industrial components can be described on type or instance level.

The aim of this Submodel is to digitialize and interoperably convey sets of information to faciliate and ease engineering tasks using such industrial components. Engineering authoring systems are considered all systems concerned with selecting, dimensioning, simulating, constructing and sketching industrial systems. For the time being, this document focuses on electrical and fluidic engineering.

This Submodel template specifies a basic set of SubmodelElements in order to bring about the necessary information according to this use-case.

1.3 Relevant standards and sources of concepts for the Submodel template

1.3.1 Concept repositories

So called concept repositories or (property) dictionaries are used identify information elements (see Terms and Definitions of [6]). Such property dictionaries include:

- **ECLASS**, see: https://www.eclasscontent.com/
- **IEC CDD**, see: https://cdd.iec.ch/cdd/iec61987/iec61987.nsf and https://cdd.iec.ch/cdd/iec62683/cdddev.nsf

In this document, properties are aimed to be described by ECLASS.

1.3.2 VDI 2770

VDI 2770 [9] standardizes the documentation regarding their meta data, classification, and format. The idea is that manufacturer handovers their documentation in a standardized manner, so that it gets easier for the operator to load the documentation for a component or a complete machine (both referred to in the following as asset) into their IT infrastructure and, subsequently, that it gets easier to find relevant documents during the operation phase of an asset. The central concepts of the specification are the entities “Document” and “DocumentVersion”, that are described in an UML.

The entity "Document" describes the understanding of a document in total as a specific concept of product related information. The entity "DocumentVersion" represents a specific instance of the “Document” within its life cycle, for instance a released version of the Document.

The following diagram gives an overview on the concepts of VDI 2770.

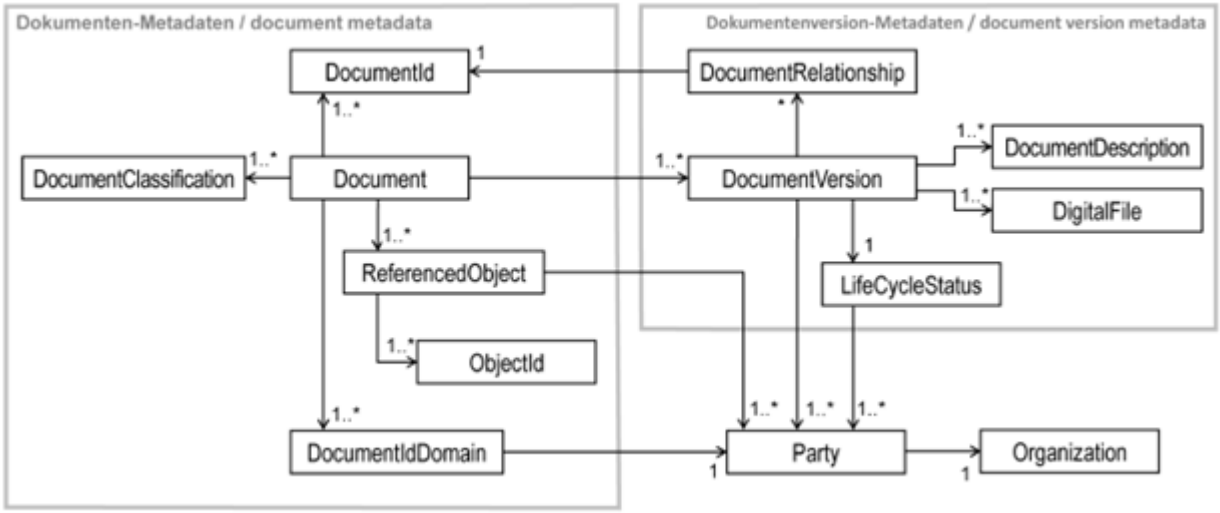

Figure 1: Overview on concepts Documents and DocumentVersion of the VDI 2770 according [9], by courtesy of VDI

1.4 Relevant existing Submodel specifications

1.4.1 Submodel Digital Nameplate

The Submodel (IDTA-2006) aims at interoperable provision of information which is conveyed also by the nameplate of an industrial equipment. Often, this information is required by regulatory guidelines such as the EU directive 2006/42/EC. It clearly identifies the described asset of the Asset Administration Shell, the manufacturer, order information, markings on the nameplate and further properties, e.g. for explosion safety.

See: https://industrialdigitaltwin.org/en/content-hub/submodels

1.4.2 Submodel Handover documentation

Scope of the Submodel (IDTA-2004) is to increase the interoperability between the parties, who are exchanging asset documentation. These parties can be manufacturer of components, complete machines or operators using these components or machines. The provided documents can contain for example information required for correct design, installation, commissioning, spare parts stocking, operation, cleaning, inspection, maintenance, and repair. In addition, there are legal regulations that stipulate the existence of certain manufacturer documents, such as CE declarations of conformity, ATEX certificates or material certificates. The structure of the Submodel is based on the structure of VDI 2770.

See: https://industrialdigitaltwin.org/en/content-hub/submodels

2 Approaches

2.1 Assets

Asset Administration Shells provide information with respect to well-identified assets. For this document, suitable assets are:

Asset	Description
Product types, such as model series of industrial components, systems	Typical application of this Submodel template. Information for engineering authoring systems is provided. Eventually, information sets need to be selected depending on different sub-types of the product type.
Product instances, such as sold individual products, industrial components, systems	Typical application of this Submodel template. Information for engineering authoring systems is provided, which is specific to the very product instance. Less ambiguities are left over.

2.2 Extension of Submodel Handover Documentation

The Submodel template specification for Handover Documentation (see 1.4.2) already comprises many features, which are required for the aims of this Submodel as well:

- understanding of documents being digital files of different formats, being human readable and/ or computer readable;
- providing multiple documents and multiple versions;
- identifying providers of information, set dates, languages, key words and more;
- (inter-) relating documents with different assets and entities;
- providing previews and multiple digital file formats;
- allowing multiple classifications of the same document.

Therefore, this Submodel template specification adds definitions and structures to the ones which are already given by the Submodel template specification for Handover Documentation. Among such definitions and structures are:

- semantic ids for Submodels based on VDI2770 structure conveying information for engineering authoring systems;
- classification systems and class ids for identifying documents relevant to such engineering authoring systems;
- collection of SubmodelElements describing interoperable sets of information.

As a consequence, software which deals with handover documentation is expected to handle Submodels according to this specification, e.g. by just matching the newly defined semantic ids. Engineering authoring systems will find more precise information to handle digital files provided by manufacturers and suppliers.

2.3 Information structuring

The SubmodelElements described in clause 4 are structured in the following way (see Figure 2).

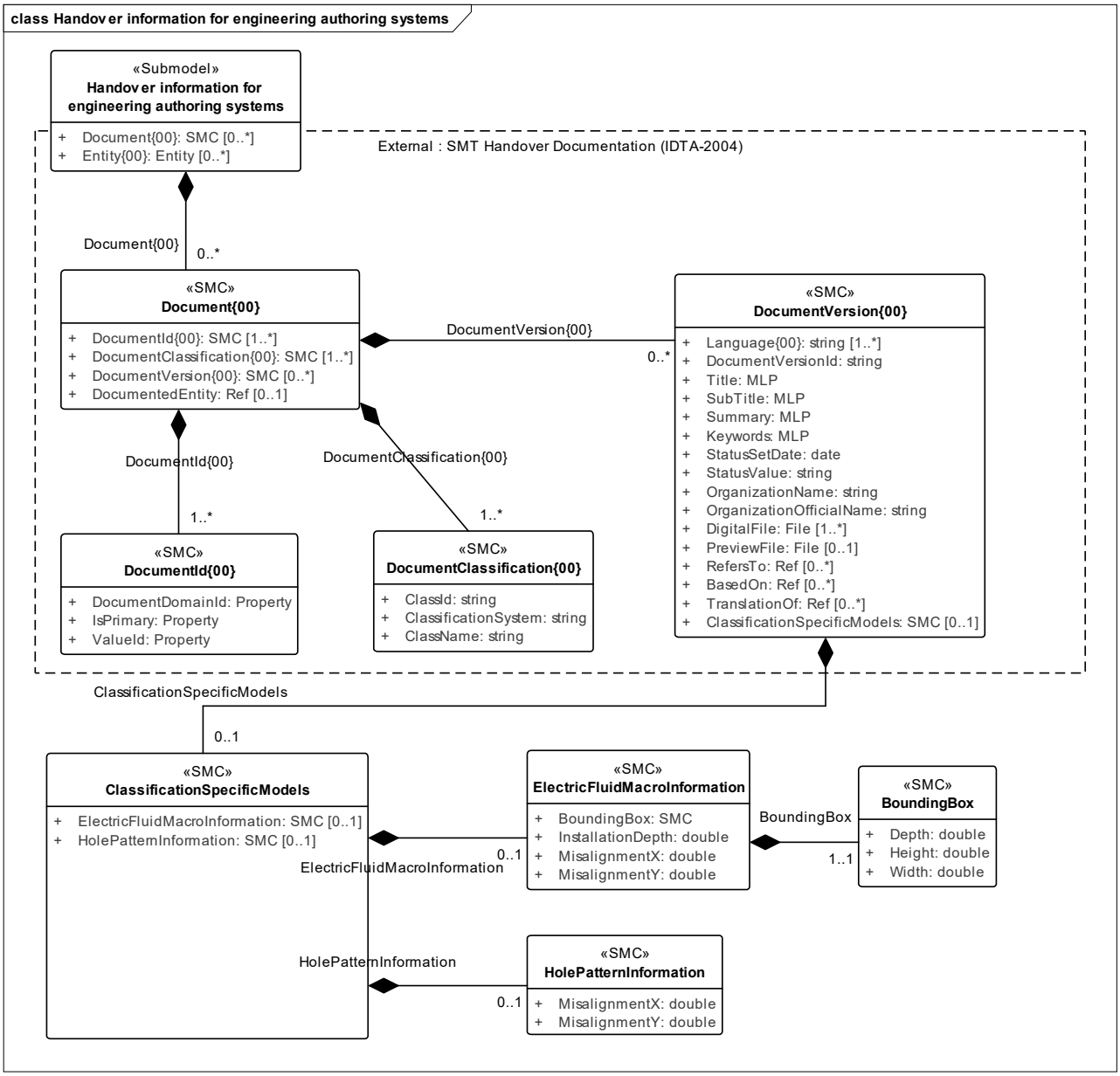

Figure 2 – Elements of the Submodel

3 Definitions

3.1 New semantic ids for Submodels

The following semantic ids shall be used for Submodels conveying information for engineering authoring systems (see Figure 1):

Table 1 – Semantic ids for Submodels

no.	domain	semanticId
1	MCAD	[IRI] https://admin-shell.io/sandbox/idta/handover/MCAD/0/1/
2	Electrical and Fluid systems CAD	[IRI] https://admin-shell.io/sandbox/idta/handover/EFCAD/0/1/
3	PLC programming	[IRI] https://admin-shell.io/sandbox/idta/handover/PLC/0/1/

Note: This document focuses on electrical and fluidic engineering, that is no. 2.
Note: The semanticIds already feature IDTA identifiers, as the open source tool AASX Package Explorer and its plug-in "document shelf" already use such identifiers.

Figure 3 illustrates the rendering of such Submodel content showing human readable and computer readable documents.

Figure 3 – Exemplary rendering of a Submodel concerning with PLC handover information

3.2 New classification systems and class ids

3.2.1 Mandatory classifications

For documents consisting of digital files for engineering authoring systems, a classification according VDI2770 is always required (see 1.4.2). Table 2 shows applicable classifications.

Table 2 – Applicable document classifications according VDI2770:2018

ClassificationSystem	ClassID	ClassName (EN)
VDI2770:2018	02-01	Technical specifiction
--"--	02-02	Drawings, plans
--"--	02-03	Assemblies
--"--	03-01	Commissioning, de-commissioning
--"--	03-02	Operation

In order to specify, that documents comprise information with respect to information models in this Submodel, additional document classifcations according Table 3 shall be added.

Table 3 – Applicable document classifications for electrical and fluid domain for specific information models

ClassificationSystem	ClassID	ClassName (EN)
VDMA-FLUID:2022	MACRO	Document specifes macro definition for an engineering autoring system.
--"--	HOLEPATTERN	Document specifes hole patterns for an engineering autoring system. Either for the mounting to the cabinet plate or such or to above modules, e.g. single valves.

3.2.2 Optional classifications

Further on, documents may be classfied with respect to the domain identifed in 3.1. Respective classifications are given in Table 4, Table 5, Table 6.

Note: These definitions will be refined for further versions of the Submodel.

Table 4 – Applicable document classifications for MCAD domain

ClassificationSystem	ClassID	ClassName (EN)
IDTA-MCAD:2022	STEP	Generic STEP format
--"--	{arbitrary}	Arbitrary format. Scope of future definitions.

Table 5 – Applicable document classifications for electrical and fluid domain for specific file formats

ClassificationSystem	ClassID	ClassName (EN)
IDTA-EFCAD:2022	GENERIC	Generic format. Not further specified.
--"--	EPLAN	Format of EPLAN authoring systems, including data files for software appications such as EPLAN P8, EPLAN Pro Panel, EPLAN Fluid See: https://www.eplan-software.com/solutions/eplan-solutions/
--"--	FLUIDDRAW	Format of FluidDraw authoring system. See: https://www.festo.com/de/en/app/fluiddraw-p6.html
--"--	{arbitrary}	Arbitrary format. Scope of future definitions.

Table 6 – Applicable document classifications for PLC programming domain

ClassificationSystem	ClassID	ClassName (EN)
IDTA-PLC:2022	GENERIC	Generic format. Not further specified.
--"--	{arbitrary}	Arbitrary format. Scope of future definitions.

4 Element specifications

4.1 Attributes of ClassificationSpecificModels

This collection can be added to the existing AAS element structures of Submodel for handover documentation (see 1.4.2). It serves as a container for the following collections, which are dependent of the classification.

idShort:	ClassificationSpecificModels		
Class:	SubmodelElementCollection		
semanticId:	[IRI] https://admin-shell.io/sandbox/idta/handover/ClassificationSpecificModels/1/0		
Parent:	ClassificationSpecificModels		
Explanation:	This collection contains models (by the means of SMCs) describing certain aspects of the information provided by the document version with reference to an assigned document classification.		
[SME type] idShort	**semanticId = [idType]value Description@en**	**[valueType] example**	**card.**
[SMC] ElectricFluidMacro-Information	[IRI]https://admin-shell.io/sandbox/idta/handover/ElectricFluidMacroInformation/1/0 This collection contains information with respect to a macro definition for an electrical or fluid power authoring system	n/a	0..1
[SMC] HolePatternInformation	[IRI]https://admin-shell.io/sandbox/idta/handover/HolePatternInformation/1/0 This collection contains information with respect to a drawing or definition model of hole patterns of assets for authoring electrical cabinets and such	n/a	0..1

4.2 Attributes of ElectricFluidMacroInformation

This collection shall be added if the Document comprises as DocumentClassification of "VDMA-FLUID:2022 / MACRO" (see 3.2.1)

idShort:	ElectricFluidMacroInformation		
Class:	SubmodelElementCollection		
semanticId:	[IRI] https://admin-shell.io/sandbox/idta/handover/ElectricFluidMacroInformation/1/0		
Parent:	ElectricFluidMacroInformation		
Explanation:	This collection contains information with respect to a macro definition for an electrical or fluid power authoring system		
[SME type] idShort	**semanticId = [idType]value Description@en**	**[valueType] example**	**card.**

[SMC] BoundingBox	[IRI]https://admin-shell.io/sandbox/idta/handover/ElectricFluidMacroInformation/BoundingBox/1/0 Bounding box informationen für authoring systems	n/a	1
[Property] InstallationDepth	[IRDI]0173-1#02-AAW366#003 Installation depth Clear space required in order to to install a given operating resource -	[double] 130	1
[Property] MisalignmentX	[IRDI]0173-1#02-BAH406#004 Misalignment Geometric distance between axes or surfaces Note: as this IRDI is used twice, the idShort needs to be exactly as stated	[double] 10.2	1
[Property] MisalignmentY	[IRDI]0173-1#02-BAH406#004 Misalignment Geometric distance between axes or surfaces Note: as this IRDI is used twice, the idShort needs to be exactly as stated	[double] 23.4	1

4.3 Attributes of BoundingBox

This collection shall be added always.

idShort:	BoundingBox		
Class:	SubmodelElementCollection		
semanticId:	[IRI] https://admin-shell.io/sandbox/idta/handover/ElectricFluidMacroInformation/BoundingBox/1/0		
Parent:	BoundingBox		
Explanation:	Bounding box informationen für authoring systems		
[SME type] idShort	**semanticId = [idType]value Description@en**	**[valueType] example**	**card.**
[Property] Width	[IRDI]0173-1#02-BAF016#006 Width for objects with orientation in preferred position during use the dimension perpendicular to height/ length/depth.	[double] 134	1
[Property] Height	[IRDI]0173-1#02-BAA020#009 Height for objects with orientation in preferred position during use the dimension perpendicular to diameter/length/width/depth.	[double] 77	1
[Property] Depth	[IRDI]0173-1#02-BAB577#008 Depth for objects with fixed orientation or in preferred utilization position, the rear , generally away from the observer expansion is described as depth.	[double] 98	1

4.4 Attributes of HolePatternInformation

This collection shall be added if the Document comprises as DocumentClassification of "VDMA-FLUID:2022 / HOLEPATTERN" (see 3.2.1)

idShort:	HolePatternInformation		
Class:	SubmodelElementCollection		
semanticId:	[IRI] https://admin-shell.io/sandbox/idta/handover/HolePatternInformation/1/0		
Parent:	HolePatternInformation		
Explanation:	This collection contains information with respect to a drawing or definition model of hole patterns of assets for authoring electrical cabinets and such		
[SME type] idShort	**semanticId = [idType]value Description@en**	**[valueType] example**	**card.**
[Property] MisalignmentX	[IRDI]0173-1#02-BAH406#004 Misalignment Geometric distance between axes or surfaces. Note: as this IRDI is used twice, the idShort needs to be exactly as stated	[double] 42.4	
[Property] MisalignmentY	[IRDI]0173-1#02-BAH406#004 Misalignment Geometric distance between axes or surfaces Note: as this IRDI is used twice, the idShort needs to be exactly as stated	[double] 28.1	

Annex A. Explanations on used table formats

1. General

The used tables in this document try to outline information as concise as possible. They do not convey all information on Submodels and SubmodelElements. For this purpose, the definitive definitions are given by the following annex in form of an XML mapping of the Submodel template and its elements.

2. Tables on Submodels and SubmodelElements

For clarity and brevity, a set of rules is used for the tables for describing Submodels and SubmodelElements.

- The tables follow in principle the same conventions as in [5].
- The table heads abbreviate 'cardinality' with 'card'.
- The tables often place two informations in different rows of the same table cell. In this case, the first information is marked out by sharp brackets [] from the second information. A special case are the semanticIds, which are marked out by the format: (type)(local)[idType]value.
- The types of SubmodelElements are abbreviated:

SME type	SubmodelElement type
Property	Property
MLP	MultiLanguageProperty
Range	Range
File	File
Blob	Blob
Ref	ReferenceElement
Rel	RelationshipElement
SMC	SubmodelElementCollection
SME, SubmodelElement	SubmodelElement

- If an idShort ends with '{00}', this indicates a suffix of the respective length (here: 2) of decimal digits, in order to make the idShort unique. A different idShort might be choosen, as long as it is unique in the parents context.
- The Keys of semanticId in the main section feature only idType and value, such as: [IRI]https://admin-shell.io/vdi/2770/1/0/DocumentId/Id. The attributes "type" and "local" (typically "ConceptDescription" and "(local)" or "GlobalReference" and (no-local)") need to be set accordingly; see [6].
- If a table does not contain a column with "parent" heading, all represented attributes share the same parent. This parent is denoted in the head of the table.
- Multi-language strings are represented by the text value, followed by '@'-character and the ISO639 language code: example@EN.
- The [valueType] is only given for Properties.

Annex B. Bibliography

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