IDTA 02003-1-2 Generic Frame for Technical Data for Industrial Equipment in Manufacturing

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SPECIFICATION

Submodel Template of the
Asset Administration Shell

Imprint

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2020-11-24	1.1	This version is the first version officially published by ZVEI and Plattform Industrie 4.0. It is succeeding the version 1.0.
2022-08-04	1.2	Release of the official Submodel template published by IDTA.

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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].

The target group 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 technical data describing the asset of the respective Asset Administration Shell. Central element is the provision of properties [7], ideally interoperable by the means of dictionaries such as ECLASS and IEC CDD (Common data dictionary).

The intended use-case is, that a manufacturer of industrial equipment describes technical data of assets (type or instance), which are provided to the market. This description is achieved by the means of technical data (properties), which are interoperable and unambiguously understood by the other market participants, such as system integrators or operators of industrial equipment. These properties are selected for human comprehension and are not necessarily representing a full class definition within a classification system. For providing individual industrial equipments to the market, also a supplier is covered by the use-case (for this purpose seen as functioning as manufacturer).

This Submodel template specifies a basic set of SubmodelElements to provide the necessary information for this use case.

1.3 Relevant standards for the Submodel template

1.3.1 Meta model

This document currently targets meta model version V3.0RC01. Submodels and SubmodelElementCollections are used frequently as means of hierarchical structuring SubmodelElements.

1.3.2 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

2 Submodel for description by Technical Data of Industrial Equipment

2.1 Approach

A Submodel according to this Submodel template specification consists of four areas (see Figure 1), represented by four SubmodelElementCollections:

- The **General Information** section contains information which gives minimal information about the provider of the industrial equipment and the equipment itself. The aim of the provided information is to allow recognizing, if the provided technical data fits to the particular asset. A minimal set of information is given to allow a value chain partner to order or re-order the industrial equipment from the manufacturer or a supplier.
  For further identification or managing ordering processes, suitable Submodels for Identification, Nameplate and business contact points shall be consulted.

- The **Product classification** sections treats the described asset (industrial equipment) as commercial product, which is brought into the market by the manufacturer. For the asset, a product classification is given. Multiple product classifications can be stated.
  The hereby provided information targets the product classification only, the provided information does not automatically imply, that certain sets of properties need to be given, that a completeness or coherency of these sets of properties exists, or that these are to be arranged in a specific structure.

- The **Technical Properties** section contains individual SubmodelElements detailing on technical data. Technical data may be comprised of information expressed via properties or by providing additional files containing information about the asset or any other kind of provision of information about technical data of the asset.
  For the structuring of these SubmodelElements, main and subsections can be defined. However, these sections serve mainly the purpose to structure the information for human readability. Ideally, the information provided by the SubmodelElements shall stand for itself and shall be unambiguously identified by the semanticIds of the SubmodelElements.
  In any case, the SubmodelElements can be structured according to domains, aspects, groups or blocks described by the used property dictionary, such as ECLASS or IEC CDD. This structure is therefore domain specific and shall be defined by domain specific specifications, but will serve as sections for the technical properties, as well.

- The section for **Further Information** holds additional information, such as textual statements by the manufacturer and date of validity.

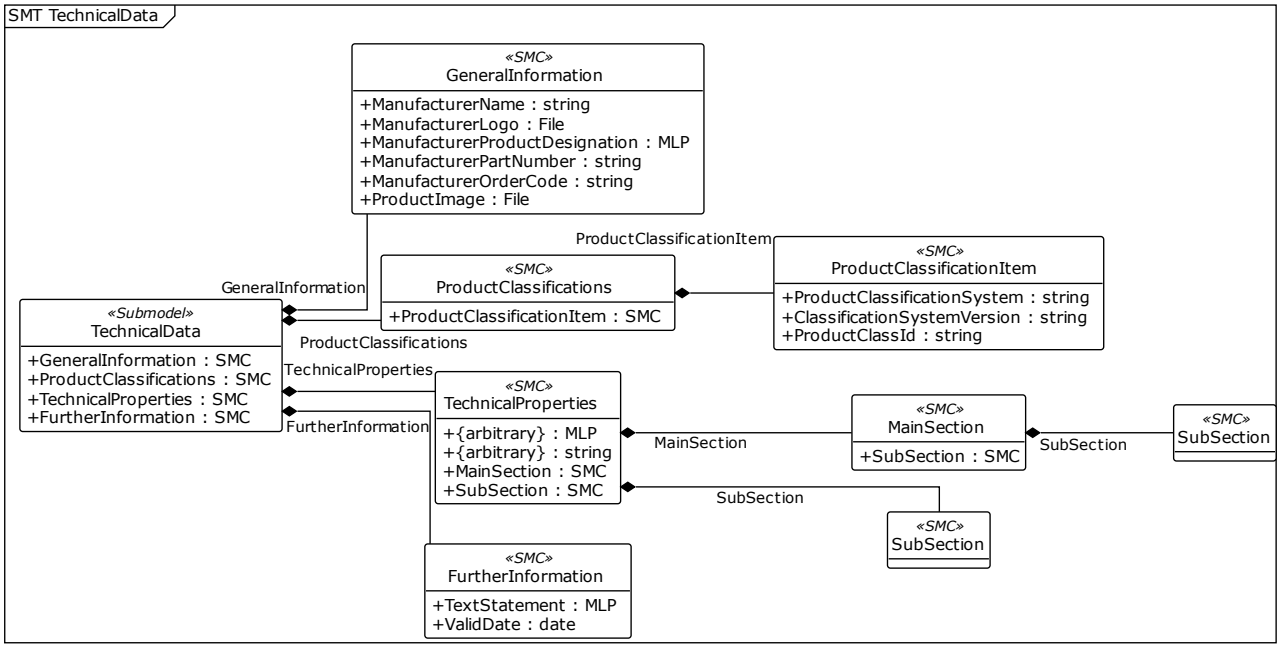

Figure 1 – Information structuring of the Submodel template

If possible, the Submodel utilizes the AAS provisions for multiple-language support. Specifically, the AAS LangStringSet data structure is used for accessing the description of SubmodelElements, the short und preferred names of ConceptDescriptions and the values of MultiLanguageProperties. By such provisions, the same technical data entities can be provided for multiple language domains required by multiple target markets of the industrial equipments and therefore fosters cross-relationships between these language domains for engineering and analytics.

Figure 2 shows, how such information might be rendered in a user application.

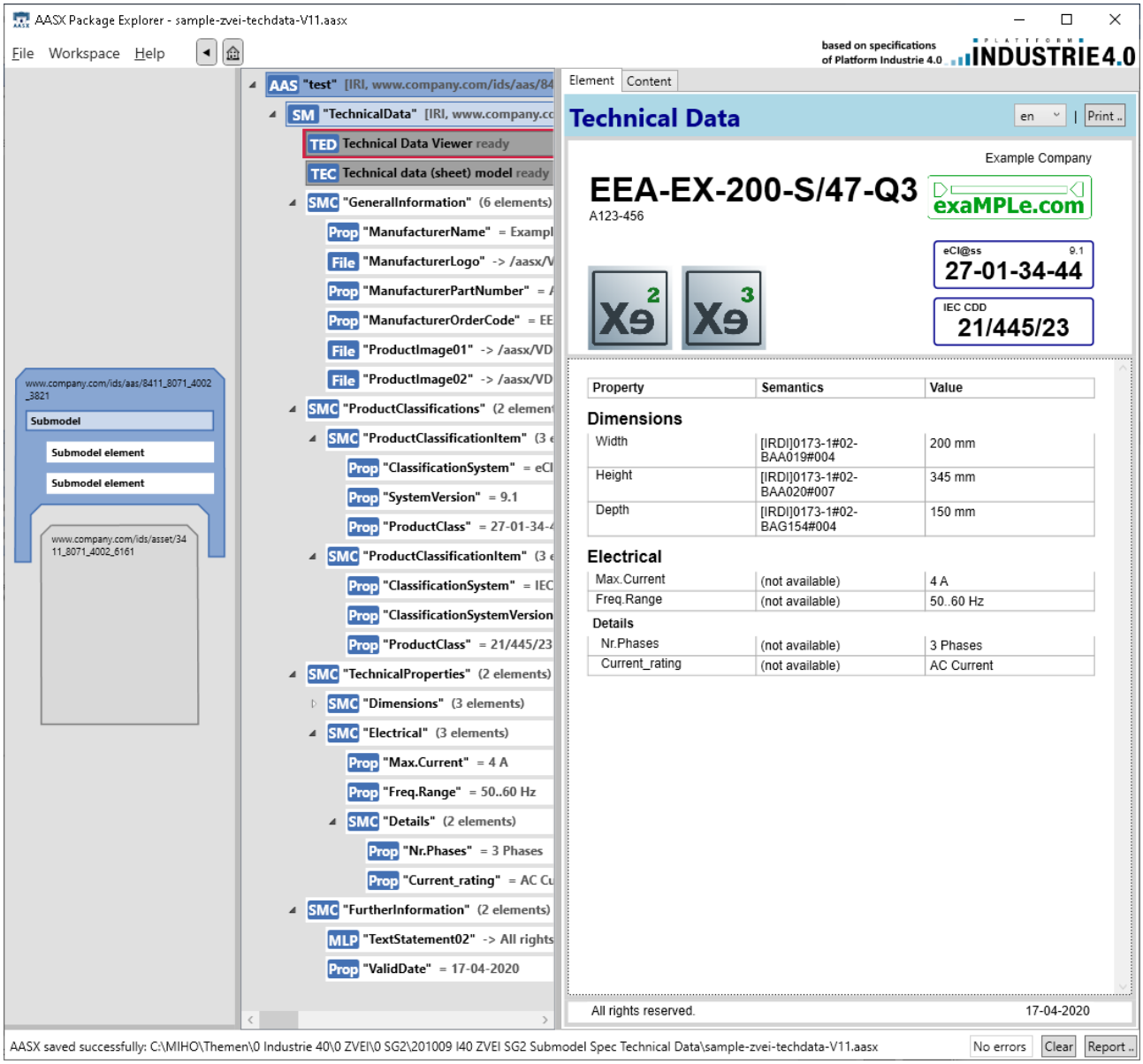

Figure 2 – Screen shot of the AASX Package Explorer with Submodel "TechnicalData" of an example asset[1], featuring multiple technical properties and visualization of the Submodel information via a specific plug-in "Technical Data Viewer"

[1] The classification of this example asset does not exist by intention

2.2 Attributes of the Submodel instance

For the Submodel instance, these important attributes need to be set:

Table 1: Attributes of the Submodel instance

idShort:	TechnicalData Note: The above idShort shall always be as stated.		
Class:	Submodel		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/Submodel/1/2		
Parent:	Asset Administration Shell with asset, which is an industrial equipment		
Explanation:	Submodel containing technical data of the asset and associated product classificatons.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] GeneralInformation	[IRI]https://admin-shell.io/ZVEI/TechnicalData/GeneralInformation/1/1 General information, for example ordering and manufacturer information.	n/a	1
[SMC] ProductClassifications	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassifications/1/1 Product classifications by association of product classes with common classification systems.	n/a	0..1
[SMC] TechnicalProperties	[IRI]https://admin-shell.io/ZVEI/TechnicalData/TechnicalProperties/1/1 Technical and product properties. Individual characteristics that describe the product and its technical properties.	n/a	1
[SMC] FurtherInformation	[IRI]https://admin-shell.io/ZVEI/TechnicalData/FurtherInformation/1/1 Further information on the product, the validity of the information provided and this data record.	n/a	0..1

2.3 SubmodelElements of General Information

The SubmodelElementCollection (SMC) described as follows contains the general information according to the approach in 2.1.1. The table convention is explained in Annex A.2.

Table 2: SubmodelElements of General Information

idShort:	GeneralInformation Note: The above idShort shall always be as stated.		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/GeneralInformation/1/1		
Parent:	Submodel with idShort = TechnicalData.		
Explanation:	General information, for example ordering and manufacturer information.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Property] ManufacturerName	[IRDI] 0173-1#02-AAO677#002 Legally valid designation of the natural or judicial body which is directly responsible for the design, production, packaging and labeling of a product in respect to its being brought into the market.	[string] Example Company	1
[File] ManufacturerLogo	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ManufacturerLogo/1/1 Imagefile for logo of manufacturer provided in common format (.png, .jpg).	MimeType = image/png Value = /aasx/TechnicalData/logo.png	0..1
[MLP] ManufacturerProductDesignation	[IRDI] 0173-1#02-AAW338#001 Product designation as given by the manufacturer. Short description of the product, product group or function (short text) in common language. Note: Whenever possible, a multi-language definition is preferred.	[langString] Electrical energy accelerator@en Elektrischer Energie Beschleuniger@de	1
[Property] ManufacturerArticleNumber	[IRDI] 0173-1#02-AAO676#003 unique product identifier of the manufacturer Note: The manufacturer article number is represented as a string, although often a numerical id.	[string] A123-456	1
[Property] ManufacturerOrderCode	[IRDI] 0173-1#02-AAO227#002 By manufactures issued unique combination of numbers and letters used to identify the device for ordering	[string] EEA-EX-200-S/47-Q3	1
[File] ProductImage	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductImage/1/1 Image file for associated product provided in common format (.png, .jpg).	MimeType = image/jpg Value = /aasx/TechnicalData/ProdFromTop.jpg	0..*

2.4 SubmodelElements of Product Classifications

The SubmodelElementCollection (SMC) described as follows contains an arbitrary number of product classification items according to the approach in clause 2.1.1. As these items are SMCs by themselves, these are described in a second table. The table convention is explained in Annex A.2.

Table 3: SubmodelElements of Product Classifications

idShort:	ProductClassifications Note: The above idShort shall always be as stated.		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassifications/1/1		
Parent:	Submodel with idShort = TechnicalData.		
Explanation:	Product classifications by association with product classes in common classification systems.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] ProductClassificationItem{00}	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassificationItem/1/1 Single product classification item by association with product class in a particular classification system or property dictionary.		0..*

The classification items themselves are defined by the following table. The table convention is explained in Annex A.2.

Table 4: SubmodelElements of Product Classifications

idShort:	ProductClassificationItem{00}		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassificationItem/1/1		
Parent:	SubmodelElementCollection with idShort = ProductClassifications.		
Explanation:	Single product classification by association with product class in a particular classification system or property dictionary.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Property] ProductClassificationSystem	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassificationSystem/1/1 Common name of the classification system. Note: Examples for common names for classification systems are "ECLASS" or "IEC CDD".	[string] ECLASS or: IEC CDD	1
[Property] ClassificationSystemVersion	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ClassificationSystemVersion/1/1 Common version identifier of the used classification system, in order to distinguish different version of the property dictionary. Note: Casing is to be ignored.	[string] 9.0 (BASIC)	0..1
[Property] ProductClassId	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ProductClassId/1/1 Class of the associated product or industrial equipment in the classification system. According to the notation of the system. Note: Ideally, the Property/valueId is used to reference the IRI/ IRDI of the product class.	[string] 27-01-88-77 or: 0112/2///61987#ABA827#003	1

2.5 SubmodelElements of Technical Properties

The SubmodelElementCollection (SMC) described as follows contains the actual technical properties according to the approach in 2.1.1. The property instances are given by individual SubmodelElements (see [6][7]). There is no structural distinction between properties of different classification systems, as they can easily be identified by checking the heading part of the IRI or IRDI identifier of the semanticId.

Note: The property dictionary is not separated per property but can be identified by inspection the property identification.

Properties, which are part of manufacturer specifications and consortium specifications (see [3]) are supported as well, as the set of suitable semanticIds is not restricted. Even SubmodelElements without distinctive semanticId are supported by providing a reserved ConceptDescription named "SemanticIdNotAvailable".

For structuring the information elements for human readability, main sections and sub sections are supported by a distinguished ConceptDescriptions. These sections can be introduced by the provider of the information (manufacturer) to group elements into easy perceivable parts (see screenshot in clause 2.1.1). These sections do not imply consequences for the machine understanding of the information. If, however, aspects, groups or blocks are required by the particular property dictionary, such as ECLASS or IEC CDD, these elements can be introduced by SubmodelElementCollection with semanticId to that block or other respective entity, as well.

The table convention is explained in Annex A.2.

Table 5: SubmodelElements of Technical Properties

idShort:	TechnicalProperties Note: The above idShort shall always be as stated.		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/TechnicalProperties/1/1		
Parent:	Submodel with idShort = TechnicalData.		
Explanation:	Individual characteristics that describe the product (industrial equipment) and its technical properties.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SME] {arbitrary}	semanticId = {arbitrary} but defined in a classification system Arbitrary SubmodelElement with semanticId possibly referring to a ConceptDescription can be used within the Technical Properties. Note: this SME might also be a SubmodelElementCollection (SMC) with a given semanticId, which stands for a block in the given classification system (e.g. ECLASS Advanced) and should be rendered on the first level as main and on subsequent levels as subsection.	Width@en= 32 [mm]	0..*
[SME] {arbitrary}	[IRI]https://admin-shell.io/SemanticIdNotAvailable/1/1 Represents a SubmodelElement that is not described using a common classification system, a consortium specification, an open community standard, a published manufacturer specification or such. Note: The idShort of the SubmodelElement can be named accordingly. Constraints concerning the usable characters for idShort shall be respected. Note: Only perceivable by human understanding. Note: The special case of SME being a SMC is accepted, will be rendered as MainSection/ SubSection accordingly.	[string] Length	0..*
[SMC] MainSection{00}	[IRI]https://admin-shell.io/ZVEI/TechnicalData/MainSection/1/1 Main subdivision possibility for properties. Note: Each Main Section SMC may contain arbitrary sets of SubmodelElements, SemanticIdNotAvailable, SubSection.	Electrical	0..*
[SMC] SubSection{00}	[IRI]https://admin-shell.io/ZVEI/TechnicalData/SubSection/1/1 Subordinate subdivision possibility for properties. Note: Each Sub Section SMC may contain arbitrary sets of SubmodelElements, SemanticIdNotAvailable, SubSection. Note: In the hierarchy of SubmodelElements, a MainSection shall be super-ordinate to the SubSection.	Details	0..*

2.6 Display names for sections and properties with no semanticID available

For displaying property names in a user interface, the following precedence of display names shall be maintained:

Table 6: Display names for sections and properties with no semanticID available

Priority	Concept in AAS metamodel	Description
1 (highest)	SubmodelElement/displayName	Dedicated display name in several languages. Note: If a user or application requests a preferred language, then this language shall be used; default is English (en).
2	ConceptDescription/preferredName	If available, the preferred name in the requested language of the concept description defining the semantics of the element. Else, if there is a default language list defined in the application, then the corresponding preferred name in the language is chosen according to this order. Else, if available, the English preferred name of the concept description defining the semantics of the element Note: The user interface is recommended to be capable of handling presentation of at least 50 characters. Note: If a user or application requests a preferred language, then this language shall be used; default is English (en).
3	ConceptDescription/shortName	As above, but shorter definition. Note: If a user or application requests a preferred language, then this language shall be used; default is English (en).
4 (lowest)	SubmodelElement/idShort	If only available, the idShort shall be presented. Note: This is usually not language adequate and the least user orientation presentation.

Note: Consequently, for editors of instances of this Submodel Template, the following procedure is recommended to be applied:
(i) Whenever possible, include a ConceptDescription within the AAS with speaking elaboration of preferredName, shortName and definition.
(ii) If no ConceptDescription could be provided (no semanticId, that is, no formal conceptualization of the property could be given to the user), a speaking explanation shall be provided by SubmodelElement/description.
(iii) in any case, a short but speaking, unique idShort for the SubmodelElement shall be chosen, respecting the allowed characters (regex definition: [a-zA-Z0-9_-]+)

2.7 SubmodelElements of Further Information

The SubmodelElementCollection (SMC) described as follows contains some further information according to the approach in 2.1The table convention is explained in Annex A.2.

Table 7: SubmodelElements of Further Information

idShort:	FurtherInformation Note: The above idShort shall always be as stated.		
Class:	SubmodelElementCollection (SMC)		
semanticId:	[IRI]https://admin-shell.io/ZVEI/TechnicalData/FurtherInformation/1/1		
Parent:	Submodel with idShort = TechnicalData.		
Explanation:	Further information on the product, the validity of the information provided and this data record.		
[SME type]	**semanticId = [idType]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[MLP] TextStatement{00}	[IRI]https://admin-shell.io/ZVEI/TechnicalData/TextStatement/1/1 Statement by the manufacturer in text form, e.g. scope of validity of the statements, scopes of application, conditions of operation. Note: Whenever possible, a multi-language definition is preferred.	[string] Restricted use Restricted use@en Eingeschränkter Geltungsbereich@de	0..*
[Property] ValidDate	[IRI]https://admin-shell.io/ZVEI/TechnicalData/ValidDate/1/1 Denotes a date on which the data specified in the Submodel was valid from for the associated asset. Note: Often this date will be the date of the last update of the corresponding data, that are the source for the technical properties section in the master data system.	[date]	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 a separate file in form of an AASX file 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 [] form 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

- 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 chosen, as long as it is unique in the parent's 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 ISO 639 language code: example@EN.
- The [valueType] is only given for Properties.

Bibliography

[1] "Recommendations for implementing the strategic initiative INDUSTRIE 4.0", acatech, April 2013. [Online]. Available https://www.acatech.de/Publikation/recommendations-for-implementing-the-strategic-initiative-industrie-4-0-final-report-of-the-industrie-4-0-working-group/

[2] "Implementation Strategy Industrie 4.0: Report on the results of the Industrie 4.0 Platform"; BITKOM e.V. / VDMA e.V., /ZVEI e.V., April 2015. [Online]. Available: https://www.bitkom.org/noindex/Publikationen/2016/Sonstiges/Implementation-Strategy-Industrie-40/2016-01-Implementation-Strategy-Industrie40.pdf

[3] "The Structure of the Administration Shell: TRILATERAL PERSPECTIVES from France, Italy and Germany", March 2018, [Online]. Available: https://www.plattform-i40.de/I40/Redaktion/EN/Downloads/Publikation/hm-2018-trilaterale-coop.html

[4] "Beispiele zur Verwaltungsschale der Industrie 4.0-Komponente – Basisteil (German)"; ZVEI e.V., Whitepaper, November 2016. [Online]. Available: https://www.zvei.org/presse-medien/publikationen/beispiele-zur-verwaltungsschale-der-industrie-40-komponente-basisteil/

[5] "Verwaltungsschale in der Praxis. Wie definiere ich Teilmodelle, beispielhafte Teilmodelle und Interaktion zwischen Verwaltungsschalen (in German)", Version 1.0, April 2019, Plattform Industrie 4.0 in Kooperation mit VDE GMA Fachausschuss 7.20, Federal Ministry for Economic Affairs and Energy (BMWi), Available: https://www.plattform-i40.de/PI40/Redaktion/DE/Downloads/Publikation/2019-verwaltungsschale-in-der-praxis.html

[6] "Details of the Asset Administration Shell; Part 1 - The exchange of information between partners in the value chain of Industrie 4.0 (Version 3.0RC01)", November 2020, [Online]. Available: https://www.plattform-i40.de/PI40/Redaktion/EN/Downloads/Publikation/Details-of-the-Asset-Administration-Shell-Part1.html

[7] Semantic interoperability: challenges in the digital transformation age, IEC, International Electronical Commission; 2019; Available: https://basecamp.iec.ch/download/iec-white-paper-semantic-interoperability-challenges-in-the-digital-transformation-age-en/?

[8] Common terms and abbreviations according to VDI FA 7.21 Wiki; Available: http://i40.iosb.fraunhofer.de/

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