IDTA 02049 Quality Control for Machining

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SPECIFICATION

Submodel Template of the Asset Administration Shell

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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].

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 information describing quality control relevant data regarding 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 purpose of this document is to make selected specifications of Submodels in such manner that information about assets can be exchanged in a meaningful way between partners in a value creation network. It targets quality control processes and metrology data measured for parts manufactured in cyclical production processes, particularly for, but not limited to machining processes.

The intended use-case is the provision of a standardized property structure for quality control in machining, which enables the standardized and automated assignment of metrology data of manufactured parts to their production parameters.

This concept can serve as a basis for standardizing the respective Submodel. The conception is based on existing norms, studies of common practices at enterprises, directives and standards so that a far-reaching acceptance can be achieved.

Beside a standardized Submodel this template also introduces standardized SubmodelElementCollections (SMC) in order to improve the interoperability while modelling aspects of quality topics within other Submodels.

The task of quality control is to check the quality of the intermediate or/and end products against customer requirements and applicable standards through inline inspections or in offline laboratory tests. The quality control process and results must be documented and relevant quality control documents must be collected and maintained.

In the field of machining, there are already standardized characteristics for describing the dimensional and surface quality, which are used as test parameters in quality control. However, there are no standardized data formats for the representation and transmission of the definition of these characteristics across different instances. In practice, the assignment of data records from quality control to other data of the specific part, such as machine cycle data, is therefore a challenge that is often carried out manually or via automation steps individually tailored to the specific application and is therefore time-consuming and cost-intensive in operation and maintenance as well as error-prone. In particular, use cases in the area of Industry 4.0 and artificial intelligence require an efficient and error-free transfer of such data from one instance to another.

The Submodel addresses the interoperable standardized provision of data and information from quality inspections on manufactured parts, such as dimensional accuracy and surface quality. The focus of the Submodel is on machining processes. In order to achieve an easy transferability to other processes, the Submodel shall contain a section for the description of generally valid quality-relevant properties and a domain-

specific section that contains the specific aspects for machining manufacturing processes. Within the machining processes, turning, milling and drilling are considered.

1.3 Relevant standards for the Submodel template

According to [3], interoperable properties might be defined by standards, consortium specifications or manufacturer specifications. Useful standards providing sources of concepts are:

Table 1: List of standards defining interoperable properties

DIN EN ISO 14405-1:2017-07	Geometrical product specification (GPS) - Dimensional tolerancing - Part 1: Linear size dimensions (ISO 14405-1:2016) [8]
DIN EN ISO 1101:2017-09	Geometrical product specifications (GPS) - Geometrical tolerancing - Tolerances of form, orientation, location and run-out (ISO 1101:2017) [9]
DIN EN ISO 25178-601:2023-11 - Draft	Geometrical product specifications (GPS) - Surface texture: Areal - Part 601: Design and characteristics of contact (stylus) instruments (ISO/DIS 25178-601:2023) [10]
VDMA 40001-3:2023-07 - draft	OPC UA companion specification machinery 40001-3 [13]

The so-called property dictionaries are used to 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.

1.4 Use cases, requirements and design decisions

Reliable quality control is an essential part of the value chain and a key factor in the success of the company, especially for high-quality products that are manufactured using machining processes.

In quality control, the quality of the intermediate and/or end products is checked against customer requirements and applicable standards through inline inspections or offline laboratory tests. Quality control processes and results are documented and relevant quality control documents are collected and maintained.

While in statistical quality control the test results only have to be assigned to the production lot or a shift, new business use cases require the component-specific assignment of the quality data, such as part/product traceability or the use of models of artificial intelligence or machine learning for quality monitoring tasks in production.

Despite existing guidelines and standards, the assignment of data sets from quality control to other data of the specific part, such as machine cycle data, is a challenge in practice, which is often done manually or via automation steps individually tailored to the specific application and is therefore time-consuming and cost-intensive to operate and maintain, as well as being error-prone.

In order to achieve a complete, error-free and fast assignment of in-house or externally determined quality data to the part and thus to other relevant production data, it is necessary to standardize the data transfer and

to describe the individual characteristics and metadata semantically. A corresponding standardized transfer is to be made possible via the Submodel Quality Control for Machining of the Asset Administration Shell.

For manufacturing companies, this makes it easier to implement the increasingly required complete traceability of parts, since system gaps in the exchange of information can be closed, especially between the quality testing laboratory and production, but also all the way back to the design phase. Relevant quality information can also be made available via the Submodel for the Digital Product Passport planned by the EU.

In addition, the implementation of artificial intelligence and machine learning applications for quality monitoring and control tasks in production is simplified, since the training data can be automatically labeled using this solution. This opens up new potential for the realization of automated post-training of the AI models in ongoing series production.

The Submodel *Quality Control for Machining* opens up the possibility for test laboratories and test equipment/software manufacturers to read out the relevant test requirements and characteristics of the components to be tested in a standardized form and to pass on the test results in a standardized manner. This opens up new possibilities for automating the test process, from creating the test program to documenting and passing on the results.

An overview of the general use case for the Submodel Quality Control for Machining is shown in Figure 1.

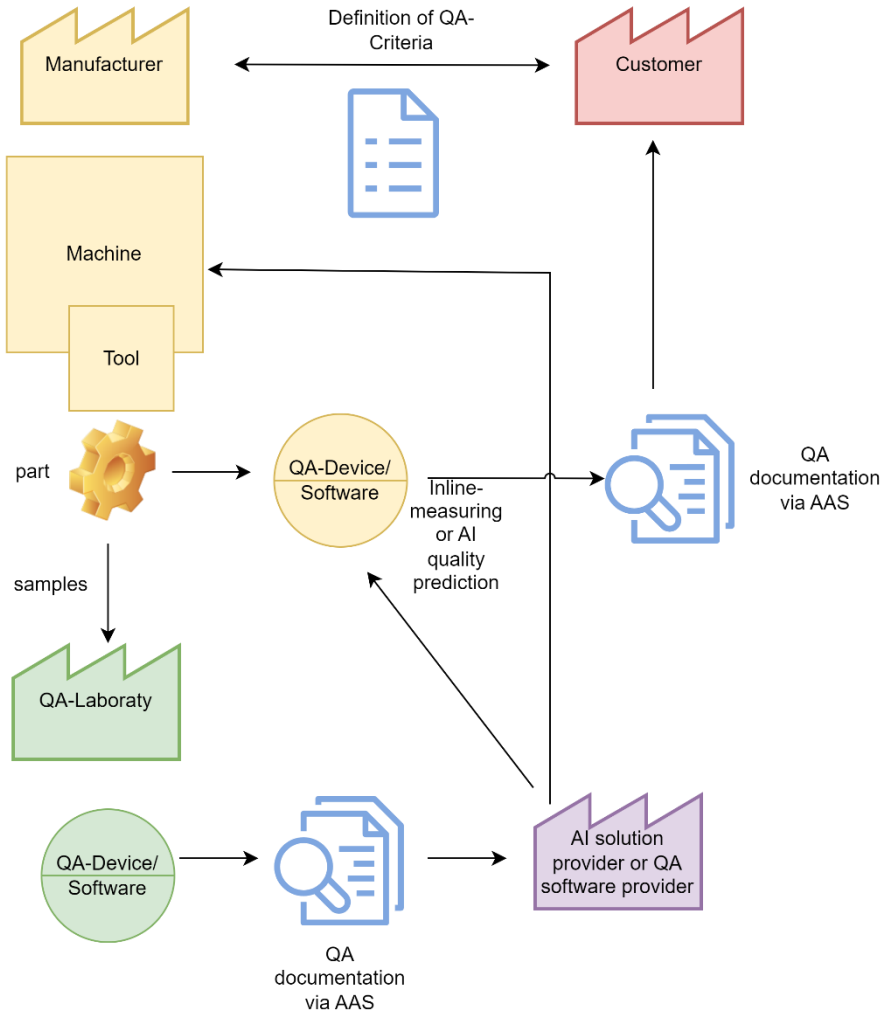

Figure 1: Overview of general use cases for Submodel *Quality Control for Machining*.

Although the Submodel is designed on the basis of machining processes, particularly turning, milling, drilling, it can be used and applied for quality control in other discrete manufacturing processes like injection moulding, aluminum casting, welding.

It is important to note that the focus of the Submodel is on the description of the end result of quality features of a manufactured product. Details on factors which influence the quality like machine, tool, workpiece are not explicitly described but can be referenced from the according AAS Submodels on technical data of these components.

1.4.1 Design decisions

In a quality control solution for manufacturing parts, semantic descriptions for interpreting data via the AAS from different relevant process steps have to be considered.

According to the process steps depicted in Figure 2 and described below, the Submodel has been subdivided into thematically separated subsections, represented by Submodel Element Collections, providing the relevant information for each process step.

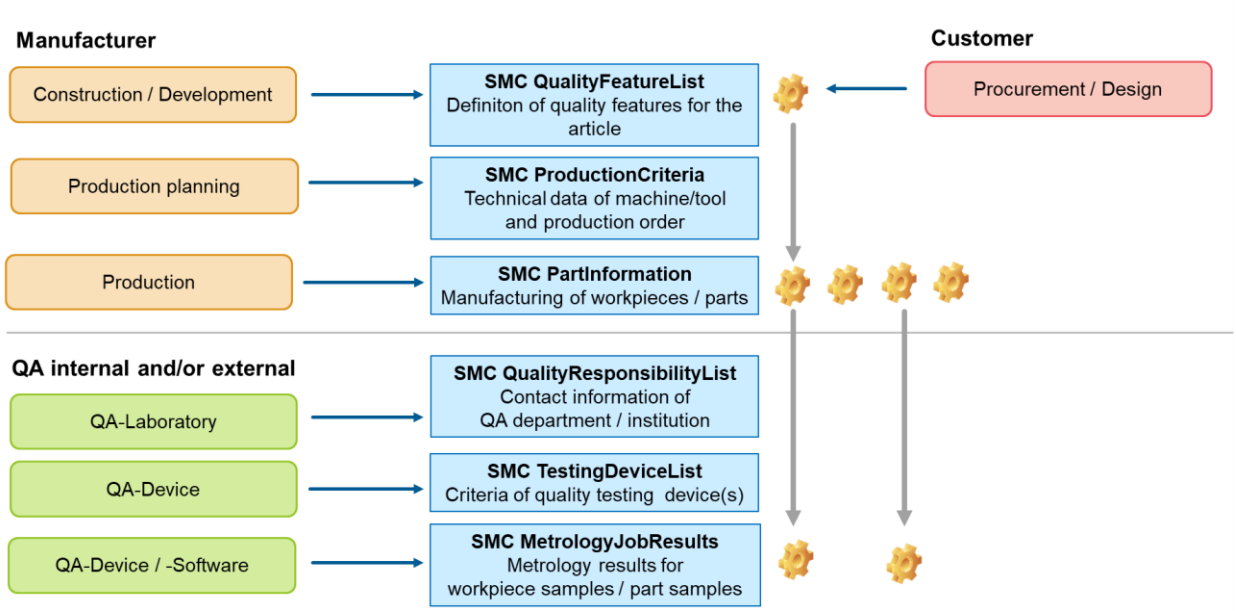

Figure 2: Relevant processes and thematic subdivision of Submodel *Quality Control for Machining*.

The relevant subsections are:

- Quality Features
- Production Criteria
- Part Information
- Quality Responsibility
- Testing Devices
- Metrology Job Results

For these subsections SMCs on the top level of the Submodels are defined. Detailed descriptions of these SMCs are provided in section 2.1 below.

1.4.1.1 Standards used for quality feature definitions

The information of the quality features provided in the submodel is derived from following standards:

- **Dimensional Tolerancing:** Linear size dimensions, according to DIN EN ISO 14405-1
- **Geometric Tolerancing:** Shape, direction, location, run, according to DIN EN ISO 1101
- **Surface Quality:** Surface specification, according to DIN EN ISO 25178-1

Additionally, attributive quality characteristics can be defined by specifying a set of attributes that determine whether the quality is within specification or out of specification.

1.4.2 Use case examples

1.4.2.1 Typical application

An automobile manufacturer (customer) commissions a supplier (manufacturing company) to manufacture a brake caliper (part) using the milling process. Due to the safety-relevant aspect of the component, the client expects component-specific traceability of quality-related data from production and the component. In order to achieve complete quality assurance, the manufacturing company would like to carry out a 100% optical inline quality control, supplemented by a quality forecast by an AI system (if necessary, provided and trained by an external AI service provider) for each component using process data from the corresponding machine cycle.

The construction of the part takes place jointly between the customer and the manufacturing company. The client specifies the quality requirements (target values and tolerances for dimensional accuracy, surface roughness and attributive features, such as freedom from burrs). In the AAS of the digital twin of the component, the corresponding quality feature types can be selected, meta information can be defined and the specific data (e.g. tolerances) can be entered via the Submodel "Quality Control for Machining".

The manufacturing company plans production on a multi-axis milling machine, selects the required milling tools (tools) and sets relevant process parameters.

Process data is collected from the manufacturing company via test series and sample parts are sent to an external quality testing laboratory to perform the metrology of the sample parts. The quality testing device there or the corresponding software has access to the administration shells of the digital twins of the sample parts and translates the information stored there directly into a test program. The measured data is stored directly in the administration shell. The manufacturing company or the AI service provider can directly assign the production process data of the parts to the quality data for the model training via the part identifier stored in their administration shell. This enables error-free automated labeling for AI model training.

In series production, the quality characteristics determined in the test laboratory could be assigned to the test objects (parts) and their production process data automatically in the same way, and the AI models can thus be automatically retrained.

The data from a seamless inline quality control in series production could also be automatically assigned to the digital twin of the specific component and the corresponding manufacturing process data via the administration shell, and part traceability could thus be implemented.

Components that do not meet the quality requirements could be rejected as NOK parts at every step of the production process via the optical inline quality control and/or the quality forecast using the AI model, which in turn saves time and money. The product-specific quality data acquisition can also be used to analyze the course of several components in order to identify systematic errors in the manufacturing process.

In the event of a subsequent complaint, the manufacturing company can evaluate the production and quality data of the specific component and prove that everything was okay in the production process.

Of course, besides full implementation, individual aspects of this practical example can be implemented as well with the Submodel Quality Control for Machining.

1.4.2.2 Demonstrational use case example

As a demonstrational use case example, a typical metal part has been constructed by the University of Bayreuth to show the capabilities and usage of the Submodel (see Figure 6, Annex B). The demonstrator part has several linear quality features like width and height as well as geometric features, e.g. perpendicularity, flatness, positions of the drilling holes, and surface properties like roughness. These have been defined in an example AAS-file together with fictional production job data and metrology results.

2 Submodel Quality Control for Machining

2.1 Approach

There are six main sections in which information is provided by the Submodel:

2.1.1.1 Quality Features

During the design phase of the article quality features are defined by the construction / design departments of the customer and/or manufacturer. According to the customer demands, nominal values and tolerance limits are defined, as well as whether the quality feature is relevant for inspection or quality assurance. The definition of quality features is documented in the CAD-file (3D-model) and/or life cycle management software.

In the Submodel, the following categories of quality features can be defined, according to the cited DIN / ISO specifications of quality assurance of geometric product specifications (GPS) [11]:

- Dimensional Tolerancing - Linear Size Dimensions (DIN EN ISO 14405-1) [8]
- Geometric tolerancing – tolerancing of shape, direction, location and run (DIN EN ISO 1101) [9]
- Surface quality – Part 1: Specification of surface quality (DIN EN ISO 25178-1) [10]

With these specifications it is possible to define quality features of **size, distance, radius, angle, form, orientation, location, run-out,** and **surface properties**.

Additionally, it is possible to define **attributive (categorial) quality features** derived from human senses, like visual inspection of surface (e.g. surface glance) or acoustic inspection of the manufacturing process (e.g. chattering), assessed by attributes like okay, not okay or 1,2,3,4,5,6.

Quality features like size, distance, radius, angle can be defined in the SMC LinearFeaturesList, whereas quality features like form, orientation, location, run-out can be defined in the SMC GeometericFeaturesList. For surface features there is a SMC ArealSurfaceFeatureList, and for attribute features the SMC AttributiveFeatures can be used.

The relevant SMC's are shown in Figure 3.

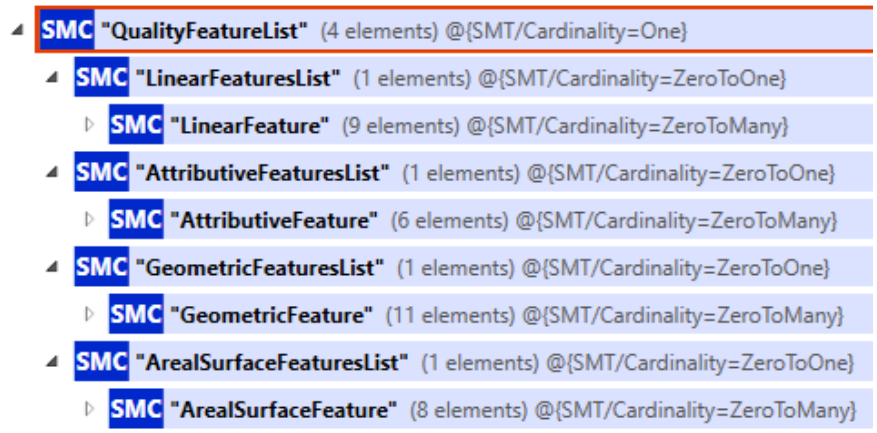

Figure 3: Relevant SMC's for defining quality features

For each quality feature it is optionally possible to reference to following external geometrical definitions:

- a list of geometry references to SMC Geometry elements in the IDTA *Submodel Provision of 3D Models* [14]
- a list of geometry IDs in an external CAD-Model (3D-Model)

- a list of geometry definitions in a 2D drawing document, provided by a page number in the document and coordinate on the page

The lists mentioned refer to the according reference to the file or document defined in the Part Information section (see below).

2.1.1.2 Production Criteria

For the production process, criteria of technical data for the machine and/or relevant tools which influence the quality of the produced part can be defined by referencing to the IDTA Submodel *Generic Frame for Technical Data for Industrial Equipment in Manufacturing* [12].

Assigning the manufactured part to the production order parameters for the production job can be done in the SMC ProductionJobOrderParameters. The relevant information and sematic description in this SMC are aligned with the OPC UA companion specification machinery (JobOrderParameters) to enable interoperability with the OPC UA standards.

Besides the assignment to a specific job order number, it is possible to describe the job order by start and end date and time, if a concrete job order number is not available.

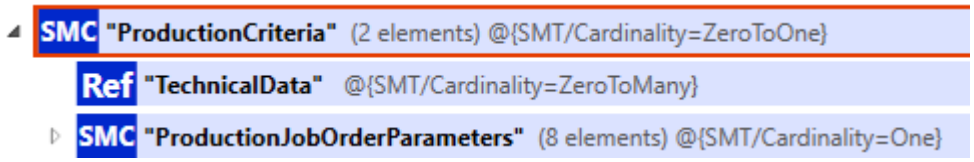

Figure 4: Relevant elements for defining the production job and technical data of the machine/tool

2.1.1.3 Part Information

To identify the part itself, there is a PartIdentifier Property in the SMC PartInformation, which refers to the AAS of the part itself. Optionally, a reference to the DigitalNameplate of the part can be provided.

Optionally, information on PartNumber which also could be interpreted as cycle number of the machine, if available can be added. Additonally, order number and lot number can be provided

Also, references to geometrical definition sources external to the Submodel can be added here optionally, specifically linking to IDTA Submodel *Provision of 3D Models* [14], a 3D CAD file, a 2D drawing document.

2.1.1.4 Quality Responsibility

In order to provide information on the department(s) or organization(s) who is/are responsible for assessing the quality features, their contact data and role can be documented in the SMC QualityResponsibilityList, via the subordinated SMC QualityResponsibility.

The contact information shall be provided by referencing to the IDTA Submodel *Contact Information* [15].

2.1.1.5 Testing Devices

In order to be able to interpret the provided information on the metrology data of the quality features it is not only necessary to provide a proper definition of the quality features (see SMC QualityFeaturesList) but also to provide relevant information about the testing device used to measure the quality.

This information can be documented in the SMC TestingDevicesList, via SMC TestingDeviceProperties. In this SMC a reference to the responsible quality department (see SMC QualityResponsibility above) can be

provided, as well as to the IDTA Submodel *Digital Quality Document* (Digital Calibration Certificate) [16], if available. To accurately interpret the metrology results, information on measurement accuracy and resolution is necessary. To identify the measuring device, device name and serial number shall be provided. Additionally, information on measuring range, measuring type and the norm according to which the measuring takes place can be added.

2.1.1.6 Metrology Job Results

The SMC MetrologyJobResults purpose is to define the metrology jobs and to provide information on the measuring results for a part or a series of parts.

The properties of this SMC are aligned to the OPC UA companion specification machinery (JobOrderParameters and JobOrderResponseData) to enable interoperability with the OPC UA standards.

Information on the metrology job order is documented via properties within the SMC MetrologyJobResults, whereas data on the metrology results are recorded in the subordinate SMC MetrologyResultsList, via SMC MetrologyData.

In the SMC MetrologyData references to the according quality feature definition as well as to the testing device used and the part for which the measurement takes place should be provided. In alignment to OPC UA companion specification machinery an ID, description and engineering unit can be provided. Depending on the type of quality feature, the actual value or attribute of the quality feature, and whether the result is in spec or not, have to be assigned.

There are additional optional properties like deviation from nominal value and min/max values as well as standard deviation. Min/max and standard deviation can be used if there are more than one measurement on the same part or in case that the provided actual value is not specific to a single part but refers to an entire series of parts (e.g. a lot or batch), for example an average value for the series of parts. This can be indicated by setting the DataAggregatedFromSeries to true.

Optionally, a list of the originally measured values can be provided (SML MeasuredValuesList), which were used to determine the actual value of the quality feature (e.g. when measuring a diameter as a mean value of a list measurements of diameters). It is also possible to refer to an external file (SMC MetrologyDataFile) containing original measurements, if the complexity of the measurements doesn’t allow to provide a simple one-dimensional list of values.

2.2 UML-Diagram of the Submodel Quality Control for Machining

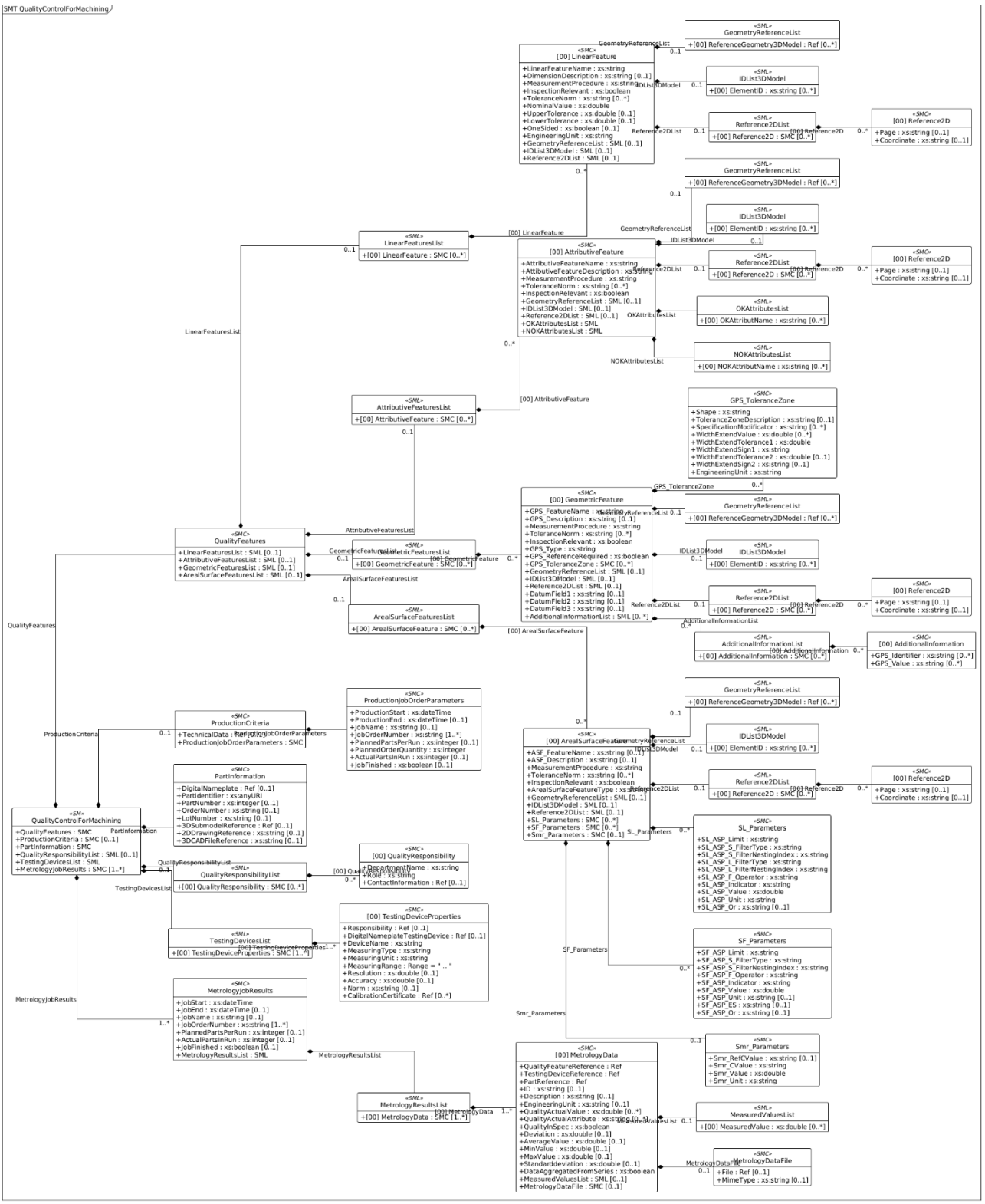

Figure 5: UML diagram of Submodel *Quality Control for Machining*

2.3 Elements of the Submodel Quality Control for Machining

Table 2 Elements of Submodel

idShort:	QualityControlForMachining		
Class:	Submodel		
semanticId:	[IRI]https://admin-shell.io/idta/SubmodelTemplate/QualityControlForMachining/1/0		
Parent	AAS		
Explanation	The Submodel Quality Control for Machining allows the collection of quality relevant information about parts produced in cyclical manufacturing processes. The focus is on looking at the production result and on machining manufacturing processes of milling, turning and drilling. However, the Submodel can also be used for other manufacturing processes.		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] QualityFeatures	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityFeatures/1/0 Quality criteria of the item and their properties	[-] n/a	1
[SMC] ProductionCriteria	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ProductionCriteria/1/0 Information on production-relevant criteria in connection with the production of a specific component	[-] n/a	0..1
[SMC] PartInformation	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PartInformation/1/0 Production information about the component	[-] n/a	1
[SML] QualityResponsibilityList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityResponsibilityList/1/0 List of organizational units responsible for quality assurance	[-] n/a	0..1
[SML] TestingDevicesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/TestingDevicesList/1/0 List of testing devices used	[-] n/a	1
[SMC] MetrologyJobResults	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MetrologyJobResults/1/0 Information and measurements on the results of a quality assessment order	[-] n/a	1..*

Table 3 Elements of SMC "QualityFeatures"

idShort:	QualityFeatures		
Class:	SubmodelElementCollection		
semanticId:	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityFeatures/1/0		
Parent	QualityControlForMachining		
Explanation	Quality criteria of the item and their properties		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SML] LinearFeaturesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/LinearFeaturesList/1/0 List of linear quality characteristics, such as dimensions, weight, angles	[-] n/a	0..1
[SML] AttributiveFeaturesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AttributiveFeaturesList/1/0 List of attributive quality characteristics	[-] n/a	0..1
[SML] GeometricFeaturesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometricFeaturesList/1/0 List of geometric quality characteristics according to DIN EN ISO 1101	[-] n/a	0..1
[SML] ArealSurfaceFeaturesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ArealSurfaceFeaturesList/1/0 List of areal surface parameters according to EN ISO 25178-1	[-] n/a	0..1

Table 4 Elements of SML "LinearFeaturesList"

idShort:	LinearFeaturesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/LinearFeaturesList/1/0		
Parent	QulityFeatures		
Explanation	List of linear quality characteristics, such as dimensions, weight, angles		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] LinearFeature	[IRI] https://admin-shell.io/idta/QualityControlForMachining/LinearFeature/1/0	[-] n/a	0..*

	Description of the definition of a linear quality characteristic such as length, weight, angle, according to DIN EN ISO 14405-1: Dimensional tolerancing - Part 1: Linear size dimensions		

Table 5 Elements of SMC "LinearFeature"

idShort:	LinearFeature		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/LinearFeature/1/0		
Parent	LinearFeatureList		
Explanation	Description of the definition of a linear quality characteristic such as length, weight, angle, according to DIN EN ISO 14405-1: Dimensional tolerancing - Part 1: Linear size dimensions		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] LinearFeatureName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/LinearFeatureName/1/0 Name or ID of the quality feature	[String] n/a	1
[Prop] DimensionDescription	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DimensionDescription/1/0 Description of the quality feature	[String] n/a	0..1
[Prop] MeasurementProcedure	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MessurementProcedure/1/0 Description of the measurement procedure, e.g. series measurements have to be averaged	[String] n/a	1
[Prop] InspectionRelevant	[IRI] https://admin-shell.io/idta/QualityControlForMachining/InspectionRelevant/1/0 Is the measurement relevant as a test measure for quality assurance? True means yes, false means no	[Boolean] n/a	1
[Prop] ToleranceNorm	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ToleranceNorm/1/0 Reference to one or more norms and guidelines in which the code for the used tolerance is defined	[String] n/a	0..*
[Prop] NominalValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/NominalValue/1/0 Value for physical quantities that may be expressed as the nominal value of the quantity together with deviations from that nominal value as percentages or absolute values	[Double] n/a	1

[Prop] UpperTolerance	[IRI] https://admin-shell.io/idta/QualityControlForMachining/UpperTolerance/1/0 Upper tolerance limit of the feature as an absolute value.If there is a one-sided tolerance, only one tolerance limit is specified.	[Double] n/a	0..1
[Prop] LowerTolerance	[IRI] https://admin-shell.io/idta/QualityControlForMachining/LowerTolerance/1/0 Lower tolerance limit of the feature as an absolute value. If there is a one-sided tolerance, only one tolerance limit is specified.	[Double] n/a	0..1
[Prop] OneSided	[IRI] https://admin-shell.io/idta/QualityControlForMachining/OneSided/1/0 Is the measure tolerated one-sidedly? True means yes, false means no. If there is a one-sided tolerance, only one tolerance limit is specified	[Boolean] n/a	0..1
[Prop] EngineeringUnit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/EngineeringUnit/1/0 Physical unit of feature	[String] n/a	1
[SML] GeometryReferenceList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometryReferenceList/1/0 Geomtery Reference List in Submodel Provision of 3D Models	[-] n/a	0..1
[SML] IDList3DModel	[IRI] https://admin-shell.io/idta/QualityControlForMachining/IDList3DModel/1/0 List of IDs in 3D Model which relate to the quality feature	[-] n/a	0..1
[SML] Reference2DList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Reference2DList/1/0 List of references to a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed	[-] n/a	0..1

Table 6 Elements of SML "AttributiveFeaturesList"

idShort:	AttributiveFeaturesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/AttributiveFeaturesList/1/0		
Parent	QualityFeatures		
Explanation	List of attributive quality characteristics		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] AttributiveFeature	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AttributiveFeature/1/0 Information about an attributive quality feature	[-] n/a	0..*

Table 7 Elements of SMC "AttributiveFeature"

idShort:	AttributiveFeature		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/AttributiveFeature/1/0		
Parent	AttributiveFeatureList		
Explanation	Information about an attributive quality feature		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] AttributiveFeatureName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AttributiveFeatureName/1/0 Name or ID of the quality feature	[String] n/a	1
[Prop] AttibutiveFeatureDescription	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AttibutiveFeatureDescription/1/0 Description of the quality feature	[String] n/a	1
[Prop] MeasurementProcedure	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MessurementProcedure/1/0 Description of the measurement procedure, e.g. series measurements have to be averaged	[String] n/a	1
[Prop] InspectionRelevant	[IRI] https://admin-shell.io/idta/QualityControlForMachining/InspectionRelevant/1/0 Is the measurement relevant as a test measure for quality assurance? True means yes, false means no	[Boolean] n/a	1

[SML] GeometryReferenceList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometryReferenceList/1/0 Geomtery Reference List in Submodel Provision of 3D Models	[-] n/a	0..1
[SML] IDList3DModel	[IRI] https://admin-shell.io/idta/QualityControlForMachining/IDList3DModel/1/0 List of IDs in 3D Model which relate to the quality feature	[-] n/a	0..1
[SML] Reference2DList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Reference2DList/1/0 List of references to a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed	[-] n/a	0..1
[SML] OKAttributesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/OKAttributesList/1/0 List of attributes that are accepted or tolerable in terms of quality assurance (OK attributes)	[-] n/a	1
[SML] NOKAttributesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/NOKAttributesList/1/0 List of attributes that are not accepted or intolerable in terms of quality assurance (not OK attributes)	[-] n/a	1

Table 8 Elements of SML "OKAttributesList"

idShort:	OKAttributesList		
Class:	SubmodelElementList		
semanticId:	[IRI] https://admin-shell.io/idta/QualityControlForMachining/OKAttributesList/1/0		
Parent	AttributiveFeature		
Explanation	List of attributes that are accepted or tolerable in terms of quality assurance (OK attributes)		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] OKAttributName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/OKAttributName/1/0 Name of an attribute that is accepted or tolerable in terms of quality assurance (OK attribute)	[String] n/a	0..*

Table 9 Elements of SML "NOKAttributesList"

idShort:	NOKAttributesList
Class:	SubmodelElementList
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/NOKAttributesList/1/0
Parent	AttributiveFeature

Explanation	List of attributes that are not accepted or intolerable in terms of quality assurance (not OK attributes)		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] NOKAttributName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/NOKAttributName/1/0 Name of an attribute that is not accepted or intolerable in terms of quality assurance (not OK attribute)	[String] n/a	0..*

Table 10 Elements of SML "GeometricFeaturesList"

idShort:	GeometricFeaturesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/GeometricFeaturesList/1/0		
Parent	Qualityfeatures		
Explanation	List of geometric quality characteristics according to DIN EN ISO 1101		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] GeometricFeature	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometricFeature/1/0 Information on a geometric quality feature according to DIN EN ISO 1101	[-] n/a	0..*

Table 11 Elements of SMC "GeometricFeature"

idShort:	GeometricFeature		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/GeometricFeature/1/0		
Parent	GeometricFeatureList		
Explanation	Information on a geometric quality feature according to DIN EN ISO 1101		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] GPS_FeatureName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_FeatureName/1/0 Name or ID of the quality feature	[String] n/a	1
[Prop] GPS_Description	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_Description/1/0 Description of the quality feature	[String] n/a	0..1
[Prop] MeasurementProcedure	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MessurementProcedure/1/0 Description of the measurement procedure, e.g. series measurements have to be averaged	[String] n/a	1

[Prop] ToleranceNorm	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ToleranceNorm/1/0 Reference to one or more norms and guidelines in which the code for the used tolerance is defined	[String] n/a	0..*
[Prop] InspectionRelevant	[IRI] https://admin-shell.io/idta/QualityControlForMachining/InspectionRelevant/1/0 Is the measurement relevant as a test measure for quality assurance? True means yes, false means no	[Boolean] n/a	1
[Prop] GPS_Type	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_Type/1/0 ValueList (straightness, flatness, roundness, cylindricity, line shape, surface shape, parallelism, perpendicularity, inclination, line profile direction, surface profile direction, position, coaxiality, concentricity, symmetry, line profile location, surface profile location, concentricity, axial runout, total concentricity, overall plan run)	[String] n/a	1
[Prop] GPS_ReferenceRequired	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_ReferenceRequired/1/0 Does a geometric reference have to be specified to make the feature unique? true corresponds to yes, false no	[Boolean] n/a	1
[SMC] GPS_ToleranceZone	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_ToleranceZone/1/0 Tolerance zone according to DIN EN ISO 1101. The tolerance zone must be arranged symmetrically around the reference geometry element, unless otherwise stated.	[-] n/a	0..*
[SML] GeometryReferenceList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometryReferenceList/1/0 Geomtery Reference List in Submodel Provision of 3D Models	[-] n/a	0..1
[SML] IDList3DModel	[IRI] https://admin-shell.io/idta/QualityControlForMachining/IDList3DModel/1/0 List of IDs in 3D Model which relate to the quality feature	[-] n/a	0..1
[SML] Reference2DList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Reference2DList/1/0 List of references to a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed	[-] n/a	0..1
[Prop] DatumField1	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DatumField1/1/0 Information about a geometric reference that is required to define the feature	[String] n/a	0..1
[Prop] DatumField2	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DatumField2/1/0 Information about a geometric reference that is required to define the feature	[String] n/a	0..1

[Prop] DatumField3	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DatumField3/1/0 Information about a geometric reference that is required to define the feature	[String] n/a	0..1
[SML] AdditionalInformationList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AdditionalInformationList/1/0 List with information on other GPS fields in accordance with DIN EN 1101	[-] n/a	0..*

Table 12 Elements of SMC "GPS_ToleranceZone"

idShort:	GPS_ToleranceZone		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/GPS_ToleranceZone/1/0		
Parent	GeometricFeature		
Explanation	Tolerance zone according to DIN EN ISO 1101. The tolerance zone must be arranged symmetrically around the reference geometry element, unless otherwise stated.		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] Shape	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Shape/1/0 Shape of the tolerance zone according to DIN EN ISO 1101	[String] n/a	1
[Prop] ToleranceZoneDescription	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ToleranceZoneDescription/1/0 Information on the partition based on the deviation from the ideal value within a certain area	[String] n/a	0..1
[Prop] MeasurementProcedure	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MessurementProcedure/1/0 Description of the measurement procedure, e.g. series measurements have to be averaged	[String] n/a	1
[Prop] SpecificationModificator	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SpecificationModificator/1/0 Specification modifier according to DIN EN ISO 14405-1: LP, LS, GG, GX, GN, GC, CC, CA, CV, SX, SN, SA, SM, SD, SR, SQ)	[String] n/a	0..*
[Prop] WidthExtendValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/WidthExtendValue/1/0	[Double] n/a	0..*

	Value for the width or extent of the tolerance zone according to DIN EN ISO 1101		
[Prop] WidthExtendTolerance1	[IRI] https://admin-shell.io/idta/QualityControlForMachining/WidthExtendTolerance1/1/0 Tolerated deviation	[Double] n/a	1
[Prop] WidthExtendSign1	[IRI] https://admin-shell.io/idta/QualityControlForMachining/WidthExtendSign1/1/0 Sign of tolerance (p, m, pm)	[String] n/a	1
[Prop] WidthExtendTolerance2	[IRI] https://admin-shell.io/idta/QualityControlForMachining/WidthExtendTolerance2/1/0 Tolerated deviation	[Double] n/a	0..1
[Prop] WidthExtendSign2	[IRI] https://admin-shell.io/idta/QualityControlForMachining/WidthExtendSign2/1/0 Sign of tolerance (p, m, pm)	[String] n/a	0..1
[Prop] EngineeringUnit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/EngineeringUnit/1/0 Physical unit of feature	[String] n/a	1

Table 13 Elements of SMC "AdditionalInformationList"

idShort:	AdditionalInformationList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/AdditionalInformationList/1/0		
Parent	GeometricFeature		
Explanation	List with information on other GPS fields in accordance with DIN EN 1101		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] AdditionalInformation	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AdditionalInformation/1/0 Informationen zu weiteren GPS-Feldern gemäß DIN EN 1101	[-] n/a	0..*

Table 14 Elements of SMC "AdditionalInformation"

idShort:	AdditionalInformation
Class:	SubmodelElementCollection
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/AdditionalInformation/1/0
Parent	AdditionalInformationList

Explanation	Informationen zu weiteren GPS-Feldern gemäß DIN EN 1101		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] GPS_Identifier	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_Identifier/1/0 Identifier of additional GPS field information according to DIN EN 1101	[String] n/a	0..*
[Prop] GPS_Value	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GPS_Value/1/0 Value of additional GPS field information according to DIN EN 1101	[String] n/a	0..*

Table 15 Elements of SML "ArealSurfaceFeaturesList"

idShort:	ArealSurfaceFeaturesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/ArealSurfaceFeaturesList/1/0		
Parent	QualityFeatures		
Explanation	List of areal surface parameters according to EN ISO 25178-1		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] ArealSurfaceFeature	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ArealSurfaceFeature/1/0 Definition of an areal surface parameter according to DIN EN ISO 25178-1	[-] n/a	0..*

Table 16 Elements of SMC "ArealSurfaceFeature"

idShort:	ArealSurfaceFeature		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/ArealSurfaceFeature/1/0		
Parent	ArealSurfaceFeatureList		
Explanation	Definition of an areal surface parameter according to DIN EN ISO 25178-1		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] ASF_FeatureName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ASF_FeatureName/1/0 Name or ID of the quality feature	[String] n/a	0..1
[Prop] ASF_Description	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ASF_Description/1/0 Description of the quality feature	[String] n/a	0..1

[Prop] ToleranceNorm	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ToleranceNorm/1/0 Reference to one or more norms and guidelines in which the code for the used tolerance is defined	[String] n/a	0..*
[Prop] InspectionRelevant	[IRI] https://admin-shell.io/idta/QualityControlForMachining/InspectionRelevant/1/0 Is the measurement relevant as a test measure for quality assurance? True means yes, false means no	[Boolean] n/a	1
[Prop] ArealSurfaceFeatureType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ArealSurfaceFeatureType/1/0 Type of surface feature according to DIN EN ISO 25178-1(Value List "S-L" or "S-F")	[String] n/a	1
[SML] GeometryReferenceList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/GeometryReferenceList/1/0 Geometry Reference List in Submodel Provision of 3D Models	[-] n/a	0..1
[SML] IDList3DModel	[IRI] https://admin-shell.io/idta/QualityControlForMachining/IDList3DModel/1/0 List of IDs in 3D Model which relate to the quality feature	[-] n/a	0..1
[SML] Reference2DList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Reference2DList/1/0 List of references to a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed	[-] n/a	0..1
[SMC] SL_Parameters	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_Parameters/1/0 Specification of an S-L surface finish according to DIN EN ISO 25178-1	[-] n/a	0..*
[SMC] SF_Parameters	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_Parameters/1/0 Specification of an S-F surface finish, see ISO 25178-2:2012, 3.1.6	[-] n/a	0..*
[SMC] Smr_Parameters	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Smr_Parameters/1/0 Control elements for specifying the parameter value Smr for the material ratio in technical drawings, applies to both S-L and S-F surface finishes, see also ISO 25178-2:2012, 3.1.6	[-] n/a	0..1

Table 17 Elements of SMC "SL_Parameters"

idShort:	SL_Parameters		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/SL_Parameters/1/0		
Parent	ArealSurfaceFeature		
Explanation	Specification of an S-L surface finish according to DIN EN ISO 25178-1		
[SME type]	semanticId = [IRI]value	[valueType]	card.
idShort	Description@en	example	
[Prop] SL_ASP_Limit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_Limit/1/0 Either U (upper) or L (lower) specification limit according to ISO 25178-1	[String] n/a	1
[Prop] SL_ASP_S_FilterType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_S_FilterType/1/0 Filter type of S-filter	[String] n/a	1
[Prop] SL_ASP_S_FilterNestingIndex	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_S_FilterNestingIndex/1/0 Nesting index of the S-filter	[String] n/a	1
[Prop] SL_ASP_L_FilterType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_L_FilterType/1/0 Filter type of L-filter	[String] n/a	1
[Prop] SL_ASP_L_FilterNestingIndex	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_L_FilterNestingIndex/1/0 Nesting index of the L-filter	[String] n/a	1
[Prop] SL_ASP_F_Operator	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_F_Operator/1/0 Type of association operator and nesting index	[String] n/a	1
[Prop] SL_ASP_Indicator	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_Indicator/1/0 Name of the areal parameter. See also ISO 25178-2:2012, 3.2	[String] n/a	1
[Prop] SL_ASP_Value	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_Value/1/0 Specified limit value of the parameter	[Double] n/a	1

[Prop] SL_ASP_Unit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_Unit/1/0 Unit of the parameter value, if it is not the default unit	[String] n/a	1
[Prop] SL_ASP_Or	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SL_ASP_Or/1/0 Symbol for the option to choose other requirements according to DIN EN ISO ISO 25178-2. Additional requirements are specified here.	[String] n/a	0..1

Table 18 Elements of SMC "SF_Parameters"

idShort:	SF_Parameters		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/SF_Parameters/1/0		
Parent	ArealSurfaceFeature		
Explanation	Specification of an S-F surface finish, see ISO 25178-2:2012, 3.1.6		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] SF_ASP_Limit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_Limit/1/0 Either U (upper) or L (lower) specification limit according to ISO 25178-1	[String] n/a	1
[Prop] SF_ASP_S_FilterType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_S_FilterType/1/0 Filter type of S-filter	[String] n/a	1
[Prop] SF_ASP_S_FilterNestingIndex	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_S_FilterNestingIndex/1/0 Nesting index of the S-filter	[String] n/a	1
[Prop] SF_ASP_F_Operator	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_F_Operator/1/0 Type of association operator and nesting index	[String] n/a	1
[Prop] SF_ASP_Indicator	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_Indicator/1/0 Name of the areal parameter. See also ISO 25178-2:2012, 3.2	[String] n/a	1
[Prop] SF_ASP_Value	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_Value/1/0	[Double] n/a	1

	Specified limit value of the parameter		
[Prop] SF_ASP_Unit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_Unit/1/0 Unit of the parameter value, if it is not the default unit (the default unit µm does not need to be specified)	[String] n/a	0..1
[Prop] SF_ASP_ES	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_ES/1/0 Choice of electromagnetic surface, according to DIN EN 25178-2	[String] n/a	0..1
[Prop] SF_ASP_Or	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SF_ASP_Or/1/0 Symbol for the option to choose other requirements according to DIN EN ISO 25178-2. Additional requirements are specified here.	[String] n/a	0..1

Table 19 Elements of SMC "Smr_Parameters"

idShort:	Smr_Parameters		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/Smr_Parameters/1/0		
Parent	ArealSurfaceFeature		
Explanation	Control elements for specifying the parameter value Smr for the material ratio in technical drawings, applies to both S-L and S-F surface finishes, see also ISO 25178-2:2012, 3.1.6		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] Smr_RefCValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Smr_RefCValue/1/0 Specification of the reference level as a percentage of the material proportion curve, see ISO 25178-2:2012, 4.4.3. The default reference is the highest point 0% of the material proportion curve and does not need to be specified.	[String] n/a	0..1
[Prop] Smr_CValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Smr_CValue/1/0 Set height distance in relation to the reference c value in µm, see ISO 25178-2:2012, 4.4.2. The c-value is negative if it is below the reference c-value and is positive if it is is above the reference c value	[String] n/a	1
[Prop] Smr_Value	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Smr_Value/1/0 Specified limit value of the parameter	[Double] n/a	1

[Prop] Smr_Unit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Smr_Unit/1/0 Unit, default: %, must always be specified	[String] n/a	1

Table 20 Elements of SML "GeometryReferenceList"

idShort:	GeometryReferenceList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/GeometryReferenceList/1/0		
Parent	• LinearFeaturesList • AttributiveFeaturesList • GeometricFeaturesList • ArealSurfaceFeaturesList		
Explanation	Geomtery Reference List in Submodel Provision of 3D Models		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Ref] ReferenceGeometry3DModel	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ReferenceGeometry3DModel/1/0 Reference to a Geomatry element described by a SMC Geometry in the Submodel Provision of 3D Models	[-] n/a	0..*

Table 21 Elements of SML "IDList3DModel"

idShort:	IDList3DModel		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/IDList3DModel/1/0		
Parent	• LinearFeaturesList • AttributiveFeaturesList • GeometricFeaturesList • ArealSurfaceFeaturesList		
Explanation	List of IDs in 3D Model which relate to the quality feature		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] ElementID	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ElementID/1/0 One element ID which relates to the quality feature	[String] n/a	0..*

Table 22 Elements of SML "Reference2DList"

idShort:	Reference2DList
Class:	SubmodelElementList

semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/Reference2DList/1/0		
Parent	• LinearFeaturesList • AttributiveFeaturesList • GeometricFeaturesList • ArealSurfaceFeaturesList		
Explanation	List of references to a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] Reference2D	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Reference2D/1/0 Reference to an element in a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed	[-] n/a	0..*

Table 23 Elements of SMC "Reference2D"

idShort:	Reference2D		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/Reference2D/1/0		
Parent	Reference2DList		
Explanation	Reference to an element in a 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] Page	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Page/1/0 Page in the 2D document where the quality feature is illustrated	[String] n/a	0..1
[Prop] Coordinate	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Coordinate/1/0 Coordinate of the quality feature in a 2D document, e.g., 1B	[String] n/a	0..1

Table 24 Elements of SMC "ProductionCriteria"

idShort:	ProductionCriteria		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/ProductionCriteria/1/0		
Parent	QualityControlForMachining		
Explanation	Information on production-relevant criteria in connection with the production of a specific component		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**

idShort	Description@en	example	
[Ref] TechnicalData	[IRI] https://admin-shell.io/idta/QualityControlForMachining/TechnicalData/1/0 Reference to the AAS Submodel Technical Data for Industrial Equipment in Manufacturing	[-] n/a	0..1
[SMC] ProductionJobOrderParameters	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ProductionJobOrderParameters/1/0 Production order information	[-] n/a	1

Table 25 Elements of SMC "ProductionJobOrderParameters"

idShort:	ProductionJobOrderParameters		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/ProductionJobOrderParameters/1/0		
Parent	ProductionCriteria		
Explanation	Production order information		
[SME type]	semanticId = [IRI]value	[valueType]	card.
idShort	Description@en	example	
[Prop] ProductionStart	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ProductionStart/1/0 Date and time when production started for the production order	[DateTime] n/a	1
[Prop] ProductionEnd	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ProductionEnd/1/0 Date and time when production ended for the production order	[DateTime] n/a	0..1
[Prop] JobName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobName/1/0 Human readable name of the job. Array shall always contain the same text, potentially in different languages.	[String] n/a	0..1
[Prop] JobOrderNumber	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobOrderNumber/1/0 The OrderNumbers are used to reference company internal ERP orders the job order belongs to. Shall be provided in JobOrderParameters if any planned produced material uses OrderNumber as Identification and shall contain all those OrderNumbers.	[String] n/a	1..*
[Prop] PlannedPartsPerRun	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PlannedPartsPerRun/1/0 The number of parts produced by one run	[Integer] n/a	0..1

[Prop] PlannedOrderQuantity	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PlannedOrderQuantity/1/0 The planned order quantity shall be the planned quantity of products for a production order (lot size, production order quantity). [Source: ISO 22400]	[Integer] n/a	1
[Prop] ActualPartsInRun	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ActualPartsInRun/1/0 The number of parts actually measuerd by one run	[Integer] n/a	0..1
[Prop] JobFinished	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobFinished/1/0 Status order completed. True: yes, false: no	[Boolean] n/a	0..1

Table 26 Elements of SMC "PartInformation"

idShort:	PartInformation		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/PartInformation/1/0		
Parent	QualityControlForMachining		
Explanation	Production information about the component		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Ref] DigitalNameplate	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DigitalNameplate/1/0 Reference to the component's Digital Nameplate submodel, including details such as serial number, product family, product type, and manufacturer.	[-] n/a	0..1
[Prop] PartIdentifier	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PartIdentifier/1/0 Reference to the AAS of the component: IRDI of the management shell of the component, which is carried in the machine to assign the manufacturing data for the component	[AnyUri] n/a	1
[Prop] PartNumber	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PartNumber/1/0 Consecutive number of the manufactured component in the batch from the CNC	[Integer] n/a	0..1
[Prop] OrderNumber	[IRI] https://admin-shell.io/idta/QualityControlForMachining/OrderNumber/1/0 Identifier to identify the order. Shall be provided if defined in OutputInfo.	[String] n/a	0..1
[Prop] LotNumber	[IRI] https://admin-shell.io/idta/QualityControlForMachining/LotNumber/1/0	[String] n/a	0..1

	Identifier to identify the production lot. Shall be provided if defined in OutputInfo.		
[Ref] SubmodelReference3D	[IRI] https://admin-shell.io/idta/QualityControlForMachining/SubmodelReference3D/1/0 Reference to IDTA Submodel Provision of 3D Models	[-] n/a	0..1
[Prop] DrawingReference2D	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DrawingReference2D/1/0 Reference to a pdf-file containing the 2D drawing intended as a reference for humans, not for automation, as unambiguous interpretation cannot be guaranteed. All drawings referenced in the submodel have to be included in a single PDF document.	[String] n/a	0..1
[Prop] 3DCADFileReference	[IRI] https://admin-shell.io/idta/QualityControlForMachining/3DCADFileReference/1/0 Reference to a file which contains a 3D CAD model, eg. STL-file	[String] n/a	0..1

Table 27 Elements of SML "Reference2DList"

idShort:	QualityResponsibilityList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/QualityResponsibilityList/1/0		
Parent	QualityControlForMachining		
Explanation	List of organizational units responsible for quality assurance		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] QualityResponsibility	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityResponsibility/1/0 Information about an organizational unit responsible for quality assurance	[-] n/a	0..*

Table 28 Elements of SMC "QualityResponsibility"

idShort:	QualityResponsibility		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/QualityResponsibility/1/0		
Parent	QualityResponsibilityList		
Explanation	Information about an organizational unit responsible for quality assurance		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] DepartmentName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DepartmentName/1/0	[String] n/a	1

	Name of the institution/testing body		
[Prop] Role	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Role/1/0 Role of the QS testing body (e.g. external quality testing laboratory)	[String] n/a	1
[Ref] ContactInformation	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ContactInformation/1/0 Reference to the AAS submodel “Contact Information”	[-] n/a	0..1

Table 29 Elements of SMC “TestingDevicesList”

idShort:	TestingDevicesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/TestingDevicesList/1/0		
Parent	QualityControlForMachining		
Explanation	List of testing devices used		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[SMC] TestingDeviceProperties	[IRI] https://admin-shell.io/idta/QualityControlForMachining/TestingDeviceProperties/1/0 QS relevant information about the test device	[-] n/a	1..*

Table 30 Elements of SMC “TestingDeviceProperties”

idShort:	TestingDeviceProperties		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/TestingDeviceProperties/1/0		
Parent	TestingDevicesList		
Explanation	QS relevant information about the test device		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Ref] Responsibility	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Responsibility/1/0 Reference to SMC QualityResponsibility	[-] n/a	0..1
[Ref] DigitalNameplateTestingDevice	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DigitalNameplateTestingDevice/1/0 Reference to the testing device’s Digital Nameplate submodel,	[-] n/a	0..1

	including details such as serial number, product family, product type, and manufacturer.		
[Prop] DeviceName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DeviceName/1/0 Name of the test device	[String] n/a	1
[Prop] MeasuringType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MeasuringType/1/0 Type of measurement method, e.g. according to DIN EN ISO 25178-6, DIN EN ISO 25178-601, DIN EN ISO 25178-602	[String] n/a	1
[Prop] MeasuringUnit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MeasuringUnit/1/0 Unit in which the information on the measuring range and resolution is given	[String] n/a	1
[Range] MeasuringRange	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MeasuringRange/1/0 Range defined by two values of the measurand, or quantity to be supplied, within which the limits of uncertainty of the measuring instrument are specified	[-] n/a	1
[Prop] Resolution	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Resolution/1/0 Physical resolution of the measuring instrument	[Double] n/a	0..1
[Prop] Accuracy	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Accuracy/1/0 Accuracy expressed as a percentage. Containing the parameters referring to percentage measuring accuracy	[Double] n/a	0..1
[Prop] Norm	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Norm/1/0 Reference to the relevant standard in which the measuring method is described, e.g. DIN EN ISO 25178-601	[String] n/a	0..1
[Ref] CalibrationCertificate	[IRI] https://admin-shell.io/idta/QualityControlForMachining/CalibrationCertificate/1/0 Reference to AAS Submodel Digital Quality Document	[-] n/a	0..*

Table 31 Elements of SMC "MetrologyJobResults"

idShort:	MetrologyJobResults
Class:	SubmodelElementCollection
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/MetrologyJobResults/1/0
Parent	QualityControlForMachining

Explanation	Information and measurements on the results of a quality assessment order		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] JobStart	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobStart/1/0 Date time of job start	[DateTime] n/a	1
[Prop] JobEnd	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobEnd/1/0 Date time of job end	[DateTime] n/a	0..1
[Prop] JobName	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobName/1/0 Human readable name of the job. Array shall always contain the same text, potentially in different languages.	[String] n/a	0..1
[Prop] JobOrderNumber	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobOrderNumber/1/0 The OrderNumbers are used to reference company internal ERP orders the job order belongs to. Shall be provided in JobOrderParameters if any planned produced material uses OrderNumber as Identification and shall contain all those OrderNumbers.	[String] n/a	1..*
[Prop] PlannedPartsPerRun	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PlannedPartsPerRun/1/0 The number of parts planned to be measured by one run	[Integer] n/a	0..1
[Prop] ActualPartsInRun	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ActualPartsInRun/1/0 The number of parts actually measuerd by one run	[Integer] n/a	0..1
[Prop] JobFinished	[IRI] https://admin-shell.io/idta/QualityControlForMachining/JobFinished/1/0 Status order completed. True: yes, false: no	[Boolean] n/a	0..1
[SML] MetrologyResultsList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MetrologyResultsList/1/0 List of measurement results for the quality characteristics	[-] n/a	1

Table 32 Elements of SML "MetrologyResultsList"

idShort:	MetrologyResultsList
Class:	SubmodelElementList
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/MetrologyResultsList/1/0
Parent	MetrologyResults

Explanation	List of measurement results for the quality characteristics		
[SME type]	semanticId = [IRI]value	[valueType]	card.
idShort	Description@en	example	
[SMC] MetrologyData	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MetrologyData/1/0 Measurement results a quality feature	[-] n/a	1..*

Table 33 Elements of SMC "**MetrologyData**"

idShort:	MetrologyData		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/MetrologyData/1/0		
Parent	MetrologyJobResultsList		
Explanation	Measurement results a quality feature		
[SME type]	semanticId = [IRI]value	[valueType]	card.
idShort	Description@en	example	
[Ref] QualityFeatureReference	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityFeatureReference/1/0 Reference to QualityFeature in SMC QualityFeaturesList	[-] n/a	1
[Ref] TestingDeviceReference	[IRI] https://admin-shell.io/idta/QualityControlForMachining/TestingDeviceReference/1/0 Reference to the test device used in SMC TestingDeviceList	[-] n/a	1
[Ref] PartReference	[IRI] https://admin-shell.io/idta/QualityControlForMachining/PartReference/1/0 Reference to the AAS of the component if the SMC MetrologyData is not within this AAS	[-] n/a	1
[Prop] ID	[IRI] https://admin-shell.io/idta/QualityControlForMachining/ID/1/0 Name or ID of the quality feature	[String] n/a	0..1
[Prop] Description	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Description/1/0 Description of the quality feature	[String] n/a	0..1
[Prop] EngineeringUnit	[IRI] https://admin-shell.io/idta/QualityControlForMachining/EngineeringUnit/1/0 Physical unit of feature	[String] n/a	0..1
[Prop] QualityActualValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityActualValue/1/0	[Double] n/a	0..*

	Value or values (with several repeated measurements) for the specific quality feature of the component		
[Prop] QualityActualAttribute	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityActualAttribute/1/0 For attributive characteristics: attribute or attributes in the case of several repeat determinations) for the specific quality characteristic of the component	[String] n/a	0..*
[Prop] QualityInSpec	[IRI] https://admin-shell.io/idta/QualityControlForMachining/QualityInSpec/1/0 Indication whether the feature is within the tolerance, i.e. OK.	[Boolean] n/a	1
[Prop] Deviation	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Deviation/1/0 Deviation from nominal value	[Double] n/a	0..1
[Prop] AverageValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/AverageValue/1/0 Average value, if several values are measured when determining the characteristic	[Double] n/a	0..1
[Prop] MinValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MinValue/1/0 Minimum value if several values are measured when determining the quality characteristic	[Double] n/a	0..1
[Prop] MaxValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MaxValue/1/0 Maximum value if several values are measured when determining the characteristic	[Double] n/a	0..1
[Prop] Standarddeviation	[IRI] https://admin-shell.io/idta/QualityControlForMachining/Standarddeviation/1/0 Standard deviation of measuring results if several values are measured when determining the characteristic	[Double] n/a	0..1
[Prop] DataAggregatedFromSeries	[IRI] https://admin-shell.io/idta/QualityControlForMachining/DataAggregatedFromSeries/1/0 Boolean variable which indicates that the measured quality data is provided as aggregated value for a series of parts (e.g. as an average value for a lot or batch). Has to be set on false, if the measuring data is provided part specific.	[Boolean] n/a	1
[SML] MeasuredValuesList	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MeasuredValuesList/1/0 Optional list of measured values	[-] n/a	0..1

[SMC] MetrologyDataFile	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MetrologyDataFile/1/0 Optional measurement data file with the original measurement protocol	[-] n/a	0..1

Table 34 Elements of SML "MeasuredValuesList"

idShort:	MeasuredValuesList		
Class:	SubmodelElementList		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/MeasuredValuesList/1/0		
Parent	MetrologyData		
Explanation	Optional list of measured values		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] MeasuredValue	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MeasuredValue/1/0 Measured value	[Double] n/a	0..*

Table 35 Elements of SMC "MetrologyDataFile"

idShort:	MetrologyDataFile		
Class:	SubmodelElementCollection		
semanticId:	[-] https://admin-shell.io/idta/QualityControlForMachining/MetrologyDataFile/1/0		
Parent	MetrologyData		
Explanation	Optional measurement data file with the original measurement protocol		
[SME type]	**semanticId = [IRI]value**	**[valueType]**	**card.**
idShort	**Description@en**	**example**	
[Prop] FileLink	[IRI] https://admin-shell.io/idta/QualityControlForMachining/FileLink/1/0 Link to the file	[anyURI] n/a	0..1
[Prop] MimeType	[IRI] https://admin-shell.io/idta/QualityControlForMachining/MimeType/1/0 MIME type of the file	[String] n/a	0..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 information 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
SML	SubmodelElementList

- 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.

Annex B. Demonstrational Use Case Drawing

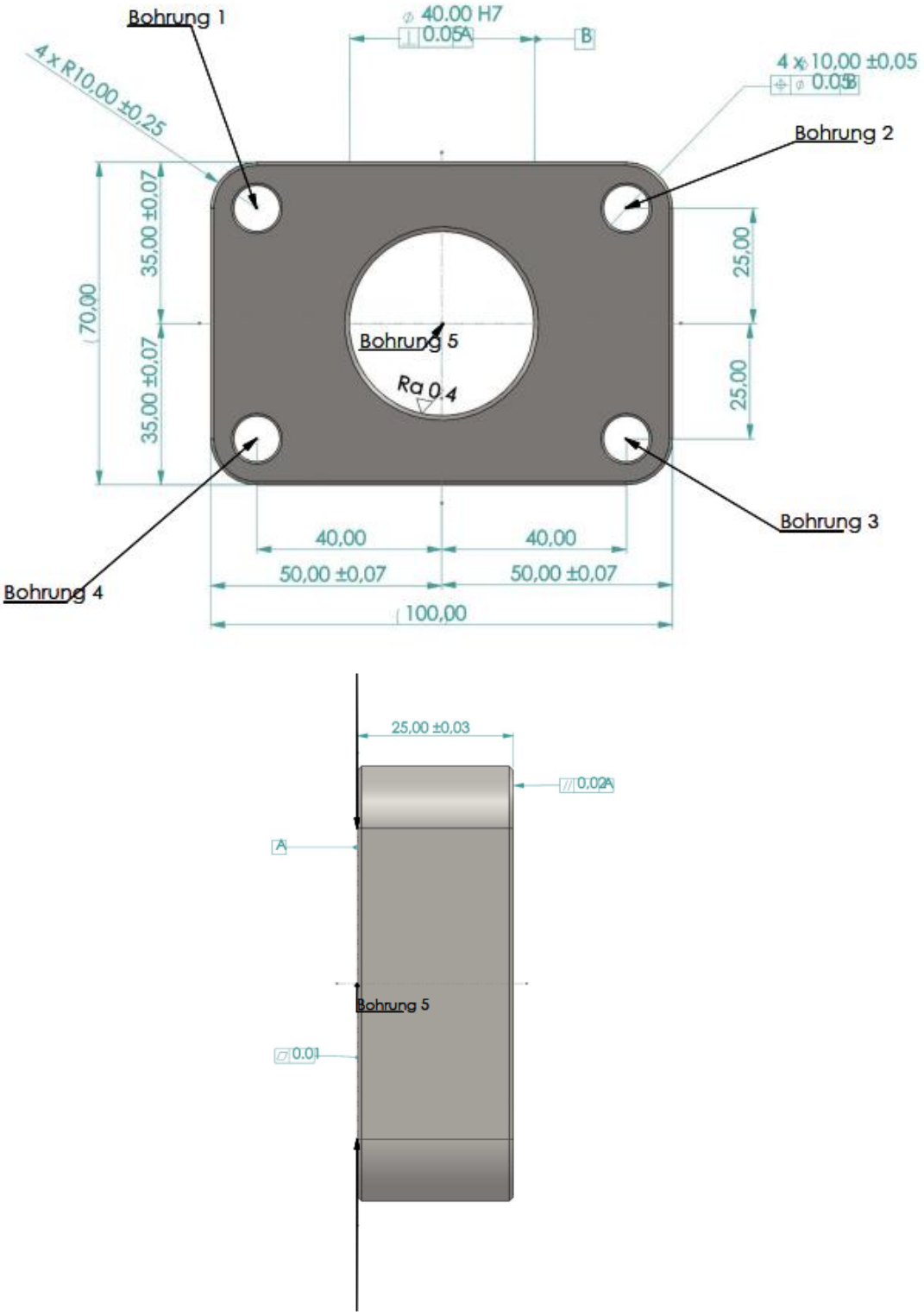

Figure 6: Drawing of a demonstrational Use Case Example by University of Bayreuth.

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