CATENA-X

STANDARD

CX - 0040 Semantic Model: Parts Analyses

BUSINESS DOMAIN: PLM & QUALITY

USE CASE: LIVE QUALITY LOOPS

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Note: Please specify the platform capability in the email subject line.

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ABOUT THIS DOCUMENT & MOTIVATION

Catena-X is the first open and collaborative data ecosystem. The goal is to provide an environment for the creation, operation, and joint use of end-to-end data chains along the entire automotive value chain. All partners are on an equal ground, have sovereign control over their data and no lock-in effects occur. This situation provides a sustainable solution for the digitalization of supply chains, especially for medium-sized and small companies, and supports the cooperation and collaboration of market participants and competitors.

The ever-growing Catena-X ecosystem will enable enormous amounts of data to be integrated and collaboratively harnessed. To ensure that these complex data volumes can be sent, received, and processed smoothly across all stages of the value chain, one language for all players: common standards.

The standards of the Catena-X data ecosystem define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

Common standards create added value for all partners: Within our network, data flows more smoothly through interfaces. In addition, we avoid cumbersome individual IT solutions for sharing data with other partners. In the field of international standardization, Catena-X follows the proven international standardization institutions: ISO/IEC/ITU and CEN-CENELC/ETSI.

For users and data providers, implementation of standards will reduce the costs that would arise from adapting different systems. In addition, no important data is lost. On the contrary, it even becomes easier to collect data across companies. For operators and developers, standards will create a framework that provides reliable orientation and planning security.

The following document describes one of the reference implementations used in the Catena-X ecosystem and the requirements needed to implement it. Here, it serves as main resource to illustrate the following data model. It contains information starting from the format of the model, up to the conceptual and physical model. Defining the data model as a reference implementation enables faster information exchange and homogeneity across the Catena-X ecosystem.

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[1] https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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[1] https://catena-x.net/de/standardisierung/catena-x-einfuehren-umsetzen/standardisierung/standard-library

MANAGEMENT SUMMARY

The Catena-X use case Live Quality Loops (QAX) provides the ability to detect quality issues the earliest possible to start root cause analyses and/or to enable an early warning feature for new quality topics. In subsequent steps counter measures can also be defined earlier and monitored. In sum, this reduces the number of vehicles affected by quality issues and increases the availability of the vehicle and built-in components. Catena-X use case Live Quality Loops is powered by Catena-X standard core components to share data from OEM and suppliers based on data sharing agreements and usage policies.

The Catena-X use case Live Quality Loops (QAX) uses multiple data models to exchange data between automotive manufacturer (OEM) and component supplier (TIER1). Each of these data models can be supplied independently.

The PartsAnalyses data model is used to exchange information about analyzed parts that were send back from the automotive manufacturer (OEM) to the part manufacturer. These analyses and their results are related to one or more quality tasks.

1 INTRODUCTION

A quality topic has different natures: Proactive quality and reactive quality work.

Example for proactive quality work: A component supplier (TIER1) releases a new component for a vehicle. The TIER1 delivers this component to an automotive manufacturer (OEM). The OEM launches a new vehicle model with this component.

For both companies, the end-user experience of this component/of the new vehicle is key. Therefore, they align in a Catena-X QualityTask to exchange anonymized component performance data from the real vehicle to closely track the behavior of this component. They use Catena-X core infrastructure to exchange relevant data and start the collaborative quality monitoring.

Example for reactive quality work: More and more end-customers are complaining about a potentially faulty component in a specific vehicle model. The component supplier (TIER1) and the automotive manufacturer (OEM) are defining a Catena-X QualityTask to eliminate this quality topic.

They use the Catena-X core infrastructure to exchange relevant data and start the collaborative quality work to define countermeasures for the root cause(s).

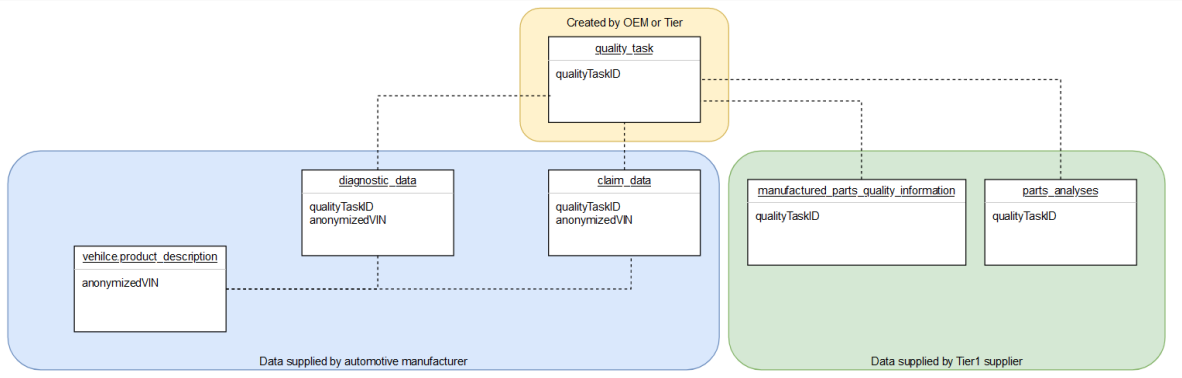

Figure 1: Hierarchy of Catena-X Live Quality Loops data models

Data models in QAX and their content:

- QualityTask is the root element and describes why companies are working together on a quality topic and what they want to do. All involved companies and their contact people are named. In addition, a flag tells what should be done with exchanged data after a QualityTask is closed.
- Vehicle.ProductDescription: This data model is a representation of one vehicle affected by this QualityTask. The model represents the vehicle when it was sold to the end-customers from an end-customers point of view: Which standard equipment was installed in the vehicle and which extra equipment was installed in the vehicle.

- Fleet.DiagnosticData: Diagnostic data coming from multiple vehicles that are affected by this QualityTask + Diagnostic data from similar vehicles that are not affected by this QualityTask.
- Fleet.ClaimData: Customer complaints that are linked to this QualityTask + Data about the exchange of potentially faulty parts
- ManufacturedPartsQualityInformation: A selection of manufacturing-related parameters that help to solve the QualityTask
- PartsAnalyses: Analyses results of replaced, potentially faulty parts, that are linked to this QualityTask

The PartsAnalyses data model consists of a list of single part analysis. The parts involved in such analyses are normally sent back from an automotive manufacturer (OEM) to the part/component manufacturer (supplier). The supplier is analyzing the part and checks whether the part is faulty or not.

Each analyzed part has a link to one quality task and multiple identifiers that allow to identify the part at manufacturers (supplier) and at customers (OEM) side. There is a status property indicating whether the analysis is still in progress. At last, there are properties about the analysis results and a flag, whether this part was really defect or not.

2 PURPOSE OF THE DOCUMENT

The purpose of this document is to make you familiar with the Catena-X use case Live Quality Loops (QAX) and the Catena-X data models that were defined by QAX. The PartsAnalyses data model consists of a list of single parts analysis and is linked to the quality task model. The parts in the model usually come back from an automotive manufacturer to the part/component manufacturer. The reader of this document should be able to understand the core principles of this Catena-X data model.

3 SCOPE OF THE IMPLEMENTATION

This chapter serves to situate the given reference implementation, to outline its prerequisites and to point out its limitations.

3.1 PRECONDITIONS AND DEPENDENCIES

Like all Catena-X data models, this model will be available in a machine-readable format on GitHub[1].

This aspect model is written in BAMM 2.0 as a modeling language, which is a separate industry standard from the open manufacturing platform, see Open Manufacturing[2].

The data contained in this Catena-X data model is requested and exchanged via Catena-X using an Eclipse Dataspace Connector (EDC), which is a separate Catena-X standard and an implementation of the IDSA standard.

3.2 CONSTRAINTS AND LIMITATIONS

There are no constraints and limitations to this reference implementation document.

3.3 LICENSE

This Catena-X data model is an outcome of Catena-X use case group Live Quality Loops (QAX).

This Catena-X data model is made available under the terms of the Creative Commons Attribution 4.0 International (CC-BY-4.0) license[3].

[1] https://github.com/eclipse-tractusx/sldt-semantic-models.

[2] https://openmanufacturingplatform.github.io/

[3] https://creativecommons.org/licenses/by/4.0/legalcode.

4 DATA MODEL

The data model is described in BAMM and is available in the semantic hub from which the following description originates.

4.1 OVERVIEW

The data model can be described in different formats. The graphical representation of this data model can be found in the annex.

Parts Analyses	
Description	List of part analyses for one quality task
Name	Parts Analyses

4.2 PROPERTIES

A property of a BAMM Aspect Meta Model represents a named value and the following are the properties that refer to the aspect of the model.

List Of several Part Analyses	
Description	A list of several part analyses
Name	listOfPartAnalyses
Characteristic	List Has a certain order Duplicates allowed Type urn:bamm:io.catenax.parts_analyses:1.0.0#PartAnalysis
Optional	No
In Payload	Yes
Payload Key	listOfPartAnalyses

4.3 ENTITIES

An entity is a logical encapsulation of multiple values. It has a number of properties, which are described in the following, starting with the entity, followed by its properties.

4.3.1 Properties of Entity Part Analysis

Part Analysis	
Description	The analysis results of ONE part
Name	Part Analysis

Catena-X ID		
Description	The fully anonymous Catena-X ID of the analyzed part - only available after digital twin registry is fully operational	
Name	catenaXIdentifier	
Characteristic	Trait Type http://www.w3.org/2001/XMLSchema#string	
Example	urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9000	
Optional	Yes	
In Payload	Yes	
Payload Key	catenaXIdentifier	
Constraints	Catena-X Id Regular Expression	
	Description	The provided regular expression ensures that the UUID is composed of five groups of characters separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 hexadecimal characters and 4 hyphens), optionally prefixed by "urn:uuid:" to make it an IRI.
	Reference	https://datatracker.ietf.org/doc/html/rfc4122
	Regular expression	(^[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{12}$)\|(^urn:uuid:[0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{12}$)

Manufacturer Part ID	
Description	Part Id of the analyzed part as assigned by the manufacturer of the part. The Part Id identifies the part type and is not unique for each serial part.
Name	manufacturerPartIdentifier
Characteristic	Type http://www.w3.org/2001/XMLSchema#string

Example	123-0.740-3434-A
Optional	No
In Payload	Yes
Payload Key	manufacturerPartIdentifier

Manufacturer serial part identifier ID	
Description	Serial Part Number of the analyzed part as assigned by the manufacturer of the part. The serial part number is unique for each serial part. Not available for all kinds of parts.
Name	manufacturerSerialPartNumber
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	436347347.4343884384.FTG.538348
Optional	Yes
In Payload	Yes
Payload Key	manufacturerSerialPartNumber

Customer part identifier	
Description	Part ID as assigned by Original Equipment Manufacturer
Name	customerPartIdentifier
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	PRT-12345
Optional	Yes
In Payload	Yes
Payload Key	customerPartIdentifier

Manufacturer part name ID	
Description	Name of the analyzed part as assigned by the manufacturer of the part
Name	nameAtManufacturer
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Steering assembly
Optional	No
In Payload	Yes
Payload Key	nameAtManufacturer

Status	
Description	Status of this part analysis
Name	status
Characteristic	Enumeration Values new in progress completed closed Type http://www.w3.org/2001/XMLSchema#string
Example	New
Optional	No
In Payload	Yes
Payload Key	status

Part defect flag	
Description	True: Analysis turned out that analyzed part is defect according to part's specification.
Name	isDefect
Characteristic	Type http://www.w3.org/2001/XMLSchema#boolean
Example	True
Optional	No
In Payload	Yes
Payload Key	isDefect

Several results of analysis	
Description	Detailed description of part analysis results
Name	resultsDescription
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	Corrossion on component xyz in steering motor
Optional	No
In Payload	Yes
Payload Key	resultsDescription

Quality Task ID	
Description	A unique quality task identifier to which this list of parts analysis belongs to
Name	qualityTaskId
Characteristic	Type http://www.w3.org/2001/XMLSchema#string
Example	BPN-811_2022_000001
Optional	No
In Payload	Yes
Payload Key	qualityTaskId

5 NORMATIVE REFERENCES

The following references refer to related Catena-X reference implementation and external standards. This is intended to place the present reference implementation in the context of existing references.

5.1 CATENA-X REFERENCE IMPLEMENTATIONS

Catena-X Reference Implementations [2]	
CX - 0003	BAMM Aspect Meta Model
CX - 0004	Governance Process
CX - 0010	Business Partner Number
CX - 0018	Eclipse Data Space Connector (EDC)

5.2 COMMON STANDARDS

Common Standards	
IDSA	International Data Spaces Association[1]

[1] https://internationaldataspaces.org/we/the-association/

[2] https://catena-x.net/de/standard-library

GLOSSARY

ABBREVIATIONS

Abbreviations	Description
BAMM	BAMM Aspect Meta Model
IDSA	International Data Spaces Association

ADDENDUM FOR CONFORMITY ASSESSMENT

DISCLAIMER

The following pages are not part of the standard documentation.

CATENA-X

ADDENDUM FOR CONFORMITY ASSESSMENT

CX – 0040 SEMANTIC MODEL: PARTS ANALYSES

BUSINESS DOMAIN: PLM & QUALITY
USE CASE: LIVE QUALITY LOOPS

Contact: standardisierung@catena-x.net
Note: Please specify the platform capability in the subject line.

TABLE OF CONTENTS

ABOUT THIS DOCUMENT & MOTIVATION

The **standards of the Catena-X data ecosystem** define how the exchange of data and information in our network works. They are the basis for ensuring that the technologies, components, and processes used are developed and operated according to uniform rules.

The addendum for conformity assessment clarifies the requirements and scope for each standard. It contains conformity assessment criteria (CAC) that specify how a participant can receive a certificate for the correct application of the standard.

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[1] https://catena-x.net/fileadmin/user_upload/Vereinsdokumente/Catena-X_IP_Regelwerk_IP_Regulations.pdf

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[1] https://catena-x.net/de/standard-library

1 INTRODUCTION

This document describes the semantic model "Parts Analyses" used in the Catena-X network.

1.1 AUDIENCE & SCOPE

This section is non-normative

The described semantic model is relevant for :

- Data Provider / Consumer
- Business Application Provider

1.2 CONTEXT

This section is non-normative

The Catena-X use case Live Quality Loops (QAX) uses multiple data models to exchange data between automotive manufacturer (OEM) and component supplier (TIER1). Each of these data models can be supplied independently.
The PartsAnalyses data model is used to exchange information about analyzed parts that were send back from the automotive manufacturer (OEM) to the part manufacturer. These analyses and their results are related to one or more quality tasks.

1.3 CONFORMANCE

As well as sections marked as non-normative, all authoring guidelines, diagrams, examples, and notes in this specification are non-normative. Everything else in this specification is normative.

The key words MAY, MUST, MUST NOT, OPTIONAL, RECOMMENDED, REQUIRED, SHOULD and SHOULD NOT in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.4 PROOF OF CONFORMITY

This section is non-normative

All participants and their solutions will need to proof, that they are conform with the Catena-X standards. To validate that the standards are applied correctly, Catena-X employs Conformity Assessment Bodies (CABs).

For Data Provider: To prove conformity you have to fulfill all MUST criteria mentioned in chapterNormative criteria for Data Provider.

There is no proof of conformity necessary for Data Consumer.

For Business Application Provider: To prove conformity you have to fulfill all MUST criteria mentioned in chapter Normative criteria for Business Application Provider.

A model validator needs to be created, to proof the correctness of the data model. A generic test set created for the model needs to proof the expected results

1.5 EXAMPLES

Example payload in JSON format:

```
{
 "listOfPartAnalyses" : [ {
  "customerPartIdentifier" : "PRT-12345",
  "resultsDescription" : "Corrossion on component xyz in steering motor",
  "qualityTaskId" : "BPN-811_2022_000001",
  "manufacturerSerialPartNumber" : "436347347.4343884384.FTG.538348",
  "catenaXIdentifier" : "urn:uuid:580d3adf-1981-44a0-a214-13d6ceed9000",
  "isDefect" : true,
  "nameAtManufacturer" : "Steering assembly",
  "manufacturerPartIdentifier" : "123-0.740-3434-A",
  "status" : "new"
 } ]
}
```

1.6 TERMINOLOGY

This section is non-normative

Business Partner Number (BPN)
A BPN is the unique identifier of a partner within Catena-x.

2 ASPECT MODEL PARTS ANALYSES

2.1 INTRODUCTION

Catena-X use case "Live Quality Loops" (QAX) uses several Catena-X standardized data models to exchange data:

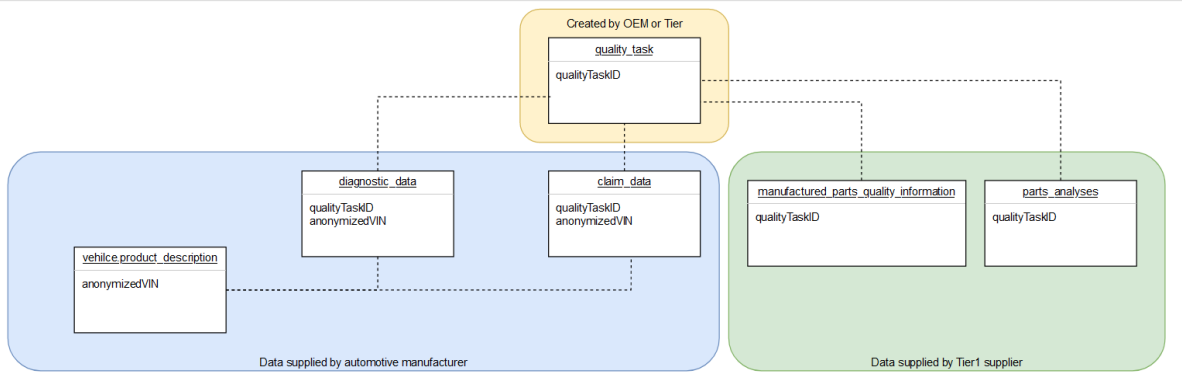

Figure 1: Hierarchy of Catena-X data models used in QAX

Data models in QAX and their content:

- QualityTask is the root element and describes why companies are working together on a quality topic and what they want to do. All involved companies and their contact people are named. In addition, a flag tells what should be done with exchanged data after a QualityTask is closed.
- Vehicle.ProductDescription: This data model is a representation of one vehicle affected by this QualityTask. The model represents the vehicle when it was sold to the end-customers from an end-customers point of view: Which standard equipment was installed in the vehicle and which extra equipment was installed in the vehicle.
- Fleet.DiagnosticData: Diagnostic data coming from multiple vehicles that are affected by this QualityTask + Diagnostic data from similar vehicles that are not affected by this QualityTask.
- Fleet.ClaimData: Customer complaints that are linked to this QualityTask + Data about the exchange of potentially faulty parts
- ManufacturedPartsQualityInformation: A selection of manufacturing-related parameters that help to solve the QualtiyTask
- PartsAnalyses: Analyses results of replaced and potentially faulty parts that are linked to this QualityTask

2.2 NORMATIVE CRITERIA

The usage of the described semantic model "Parts Analyses" is a MUST for Data Provider and Data Consumer that want to work together on a quality topic over Catena-X automotive network.

2.2.1 Normative criteria for Data Provider

Every data provider of "Parts Analyses" MUST provide the data conformant to the semantic model specified in CX-0040.

If available a data provider of "Parts Analyses" MUST provide property manufacturerSerialPartNumber for serial parts.

If available a data provider of "Parts Analyses" MUST provide manufacturerPartIdentifier for non-serial parts.

It is a MUST for data providers of "Parts Analyses" to provide the property qualityTaskId. qualityTaskId MUST match with qualityTaskId property of "Quality Task" data specified in CX – 0036.

If available catenaXIdentifier of the analyzed parts SHOULD be provided by the data provider.

In the Catena-X data space "Parts Analyses" MUST be exchanged via Eclipse Dataspace Connector (EDC) conformant to CX-0018 and CX-0002..

It is RECOMMEND to use Apache parquet[1] file format together with EDC S3 data plane for file data exchange for "Parts Analyses".

2.2.2 Normative criteria for Business Application Provider

It is a MUST for Business Application Provider to support at least 2 standardized Catena-X QAX aspect models from Catena-X Release 3.0 (2 out of Catena-X standards CX – 0036, CX – 0037, CX – 0038, CX – 0039, CX – 0040, CX – 0041) to get the label "Catena-X Certified Solution" for their quality application.

It is RECOMMEND for Business Application Provider to be able to read the semantic model "Parts Analyses".

[1] https://parquet.apache.org/

2.3 LICENSE

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The license information is available in github.

In case of doubt the license, copyright and authors information in github overwrites the information in this specification document.

2.4 IDENTIFER OF SEMANTIC MODEL

This semantic model has the unique identifier
urn:bamm:io.catenax.parts_analyses:1.0.0

2.5 FORMATS OF SEMANTIC MODEL

2.5.1 RDF Turtle

The rdf turtle file, adhering to the Semantic Aspect Meta Model, is the master for generating additional file formats and serializations. It is provided here:

https://github.com/eclipse-tractusx/sldt-semantic-models/tree/main/io.catenax.parts_analyses/1.0.0

The open source command line tool of the Eclipse Semantic Modeling Framework[2](ESMF) is used for generation of other file formats like for example a JSON Schema, aasx for Asset Administration Shell Submodel Template or a HTML documentation.

2.5.2 JSON Schema

A JSON Schema can be generated from the RDF Turtle file using the Eclipse ESMF tooling. The JSON Schema defines the Value-Only payload of the Asset Administration Shell for the API operation "GetSubmodel".
If present, example JSON-payloads MUST validate against the generated JSON schema.

[1] https://creativecommons.org/licenses/by/4.0/legalcode
[2] https://github.com/eclipse-esmf/esmf-sdk

3 REFERENCES

3.1 NORMATIVE REFERENCES

- CX – 0003 SEMANTIC ASPECT META MODEL
- CX – 0004 GOVERNANCE PROCESS FOR SEMANTIC MODELS
- CX – 0018 ECLPISE DATA SPACE CONNECTOR (EDC)