
Asset Administration Shell – AAS

Introduction, Tooling, Setup and Examples

Stupro Seminar 16.05.2025 - Junes Shirali

Introduction - Industry 4.0 and Digital Twins

Industry 4.0:

Optimization of **manufacturing** through utilizing **digital communication** and **information technologies**.

Digital Twin:

A key **concept** of industry 4.0.

A digital Twin **represents** real world assets or processes and their current state in the digital world.

Asset Administration Shells - AAS

An international Standard

What is the purpose of AAS?

- Enables **standardized description** of any kind of asset
- Provides a solution to create **manufacturer independent interoperability** between physical and non-physical entities throughout their whole lifecycle

Who specifies and develops AAS?

- The “Plattform Industrie 4.0” and “Industrial Digital Twin Association”
-

AAS - Composition

AAS:

- one aas belongs to exactly one asset
- contains **asset description**
- the aas consists of any number of submodels (modular)
- persisted as json, xml or aasx file

Submodels:

- **describe a specific aspect of an asset** using any number of “Submodel Elements”

Submodel Elements:

- for example properties, references, capabilities...([doc](#))
 - act as the **main information carrier**
-

Asset Administration Shell - Types

Type 1 passive:

Serialized Files like JSON and XML that only contain static data

Type 2 reactive:

Exist as Runtime Instances hosted on Servers, data can be accessed via api, events enable reactions to data changes, and operations can be called

Type 3 proactive:

Extends Type 2, can autonomously communicate and negotiate with other asset administration shells

```
{
  "assetAdministrationShells": [
    {
      "idShort": "CarShell",
      "id": "https://example.com/ids/aas/0300_6141_5052_8715",
      "assetInformation": {
        "assetKind": "Instance",
        "globalAssetId": "https://example.com/ids/asset/2210_6141_5052_7490",
        "specificAssetIds": []
      },
      "submodels": [
        {
          "type": "ModelReference",
          "keys": [
            {
              "type": "Submodel",
              "value": "https://example.com/ids/sm/5310_6141_5052_5359"
            }
          ]
        }
      ],
      "modelType": "AssetAdministrationShell"
    }
  ],
}
```

```
"submodels": [  
  {  
    "idShort": "TechnicalData",  
    "id": "https://example.com/ids/sm/5310_6141_5052_5359",  
    "kind": "Instance",  
    "submodelElements": [  
      {  
        "idShort": "Manufacturer",  
        "valueType": "xs:string",  
        "value": "Porsche",  
        "modelType": "Property"  
      },  
      {  
        "idShort": "Model",  
        "valueType": "xs:string",  
        "value": "911",  
        "modelType": "Property"  
      }  
    ],  
    "modelType": "Submodel"  
  }  
]
```

Working with AAS - Tools

[Eclipse AASX Package Explorer](#)

Serves the purpose of viewing and creating/editing shells, shell building kit

[FAS³T](#)

Implementation of type 2 AAS, enables creation of shells, syncing between shells and their assets and api access to shells

[Eclipse Basyx](#)

Platform for Industry 4.0 component development & Middleware, supports all aas types

[aas-test-engines](#)

Can be used to check if aas implementations are complying to standards

AASX Package Explorer V3.0 - local file:

FileWorkspaceOptionHelp

◀▶⚠

IODTA

<id unknown!>
• • •
• 1 • • •

Submodel

Submodel element

Submodel element

<id unknown!>

⌀ No information available

ElementContent

Environment of AssetInformation Administration Shells

This structure hold the main entites of Administration shells.
#admin shells: 0.
#submodels: 0.
#concept descriptions: 0.

Reload

Drag from here!

Show Content

Re-indexing Identifiables for faster access.

0 bytesNo errorsClearLog..

AASX Package Explorer V3.0 - local file:

File Workspace Option Help

← ⚠

←

Environment of AssetInformation Administration Shells

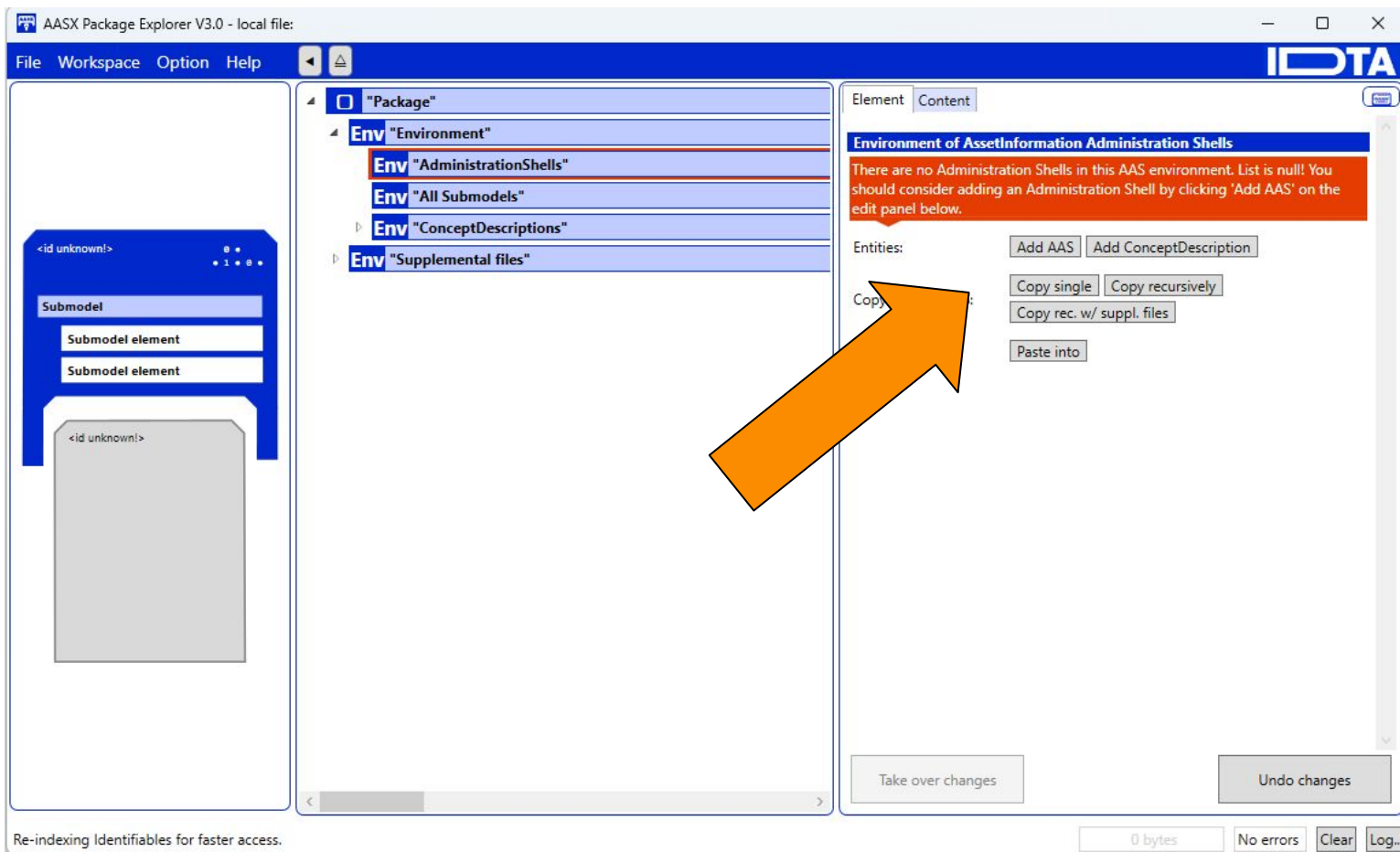
This structure hold the main entites of Administration shells.

#admin shells: 0.
#submodels: 0.
#concept descriptions: 0.

Reload Drag from here! Show Content

0 bytes No errors Clear Log..

Re-indexing Identifiables for faster access.



AASX Package Explorer V3.0 - local file:

File Workspace Option Help

Package

- Env "Environment"
 - Env "AdministrationShells"
 - Env "All Submodels"
 - Env "ConceptDescriptions"
 - Env "Supplemental files"

Submodel

- Submodel element
- Submodel element

<id unknown!>

Environment of AssetInformation Administration Shells

There are no Administration Shells in this AAS environment. List is null! You should consider adding an Administration Shell by clicking 'Add AAS' on the edit panel below.

Entities:

- Add AAS
- Add ConceptDescription
- Add Submodel instance
- Add Submodel template

Buffer:

- Paste into

Take over changes

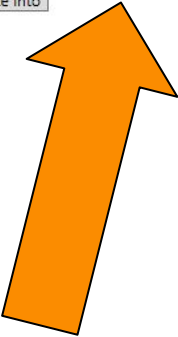
Undo changes

0 bytes

No errors

Clear

Log..



Re-indexing Identifiables for faster access.

AASX Package Explorer V3.0 - local file:

File Workspace Option Help

- New ... Ctrl+N
- Open ... Ctrl+O
- Connect ... Ctrl+Shift+I
- Save Ctrl+S
- Save as ...
- Fix and Finalize ...
- Close ...
- Check, validate and fix ...
- Security ...
- Reports ...
- Open Auxiliary AAS ... Ctrl+Shift+X
- Close Auxiliary AAS
- Further connect options ...
- AASX File Repository ...
- Import ...
- Export ...
- Server ...
- System ...
- Exit Alt+F4

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[FA³ST](#)

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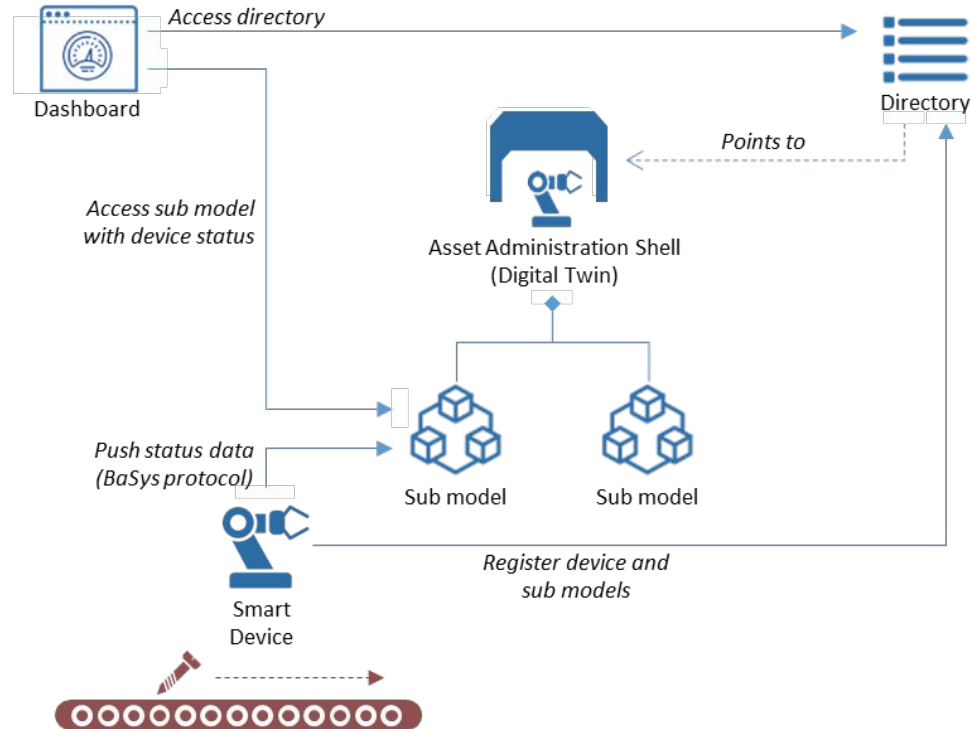
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[aas-test-engines](#)

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Basyx - Architecture Example



Basyx - test environment setup

Prerequisites:

docker-engine & docker compose, can be installed through [docker-desktop](#)

Setup:

Use the [get-started](#) kit with the following components:

- persistence backend
- aas web-ui

Post-Startup:

web-ui: <http://localhost:3000/>

swagger-ui: <http://localhost:8081/swagger-ui/index.html>

AAS - Submodel-Templates

What are Submodel-Templates?

- Consists of documentation PDF and aasx file with template

Purpose

- standardized property structure helps to create **semantic explicitness**
- semantic explicitness **reduces complexity** during modeling and development

[IDTA Submodel Templates](#)

AASX Package Explorer V3.0 - local file: U:\car.aasx buffered to: C:\Users\Junes\AppData\Local\Temp\tmpxmnp0.aasx (auxiliary AASX:...

File Workspace Option Help

- New ... Ctrl+N
- Open ... Ctrl+O
- Connect ... Ctrl+Shift+I
- Save Ctrl+S
- Save as ...
- Fix and Finalize ...
- Close ...
- Check, validate and fix ...
- Security ...
- Reports ...
- Open Auxiliary AAS ... Ctrl+Shift+X**
- Close Auxiliary AAS
- Further connect options ...
- AASX File Repository ...
- Import ...
- Export ...
- Server ...
- System ...
- Exit Alt+F4

Environment of AssetInformation Administration Shells

Entities: Add AAS Add ConceptDescription

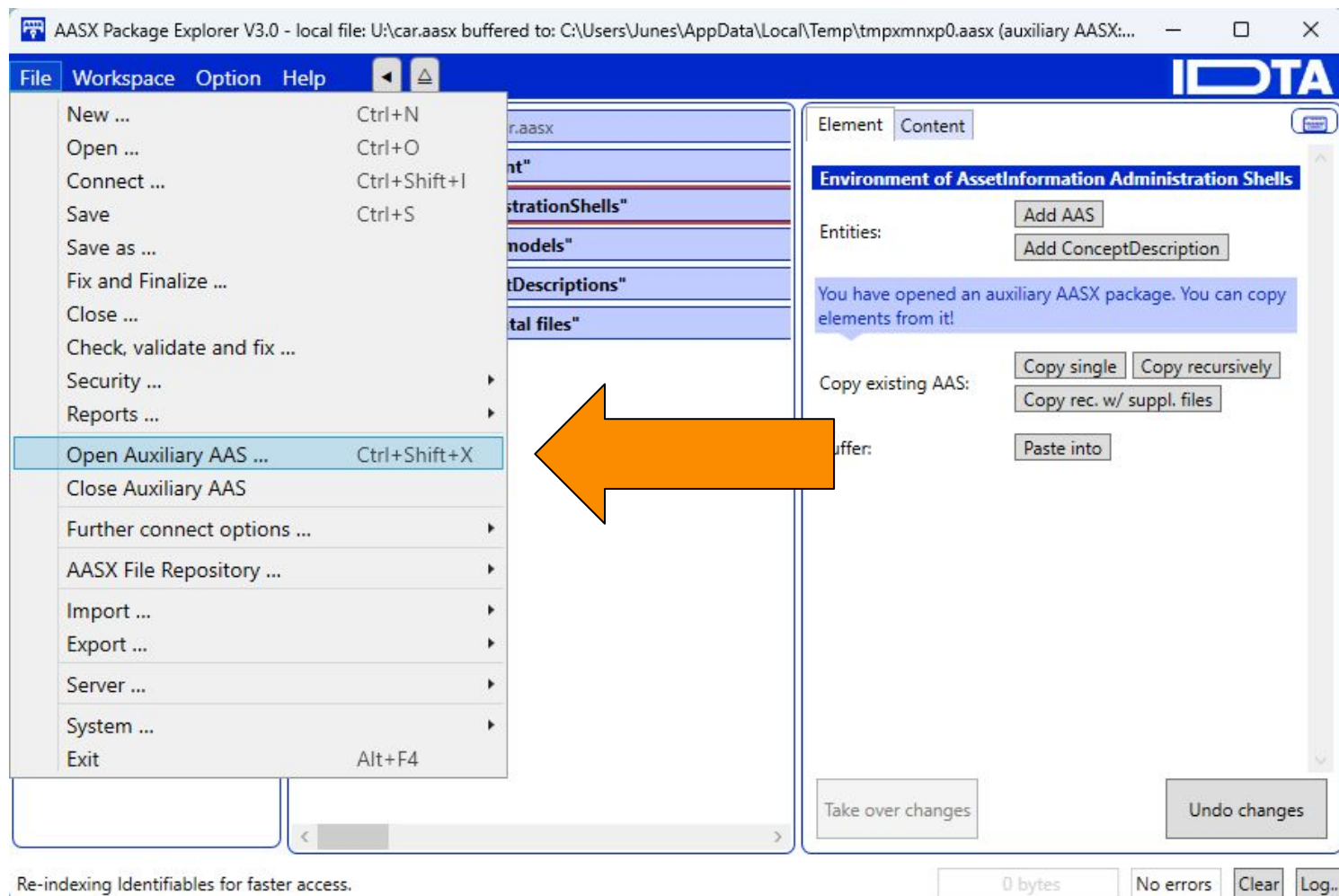
You have opened an auxiliary AASX package. You can copy elements from it!

Copy existing AAS: Copy single Copy recursively Copy rec. w/ suppl. files

buffer: Paste into

Take over changes Undo changes

0 bytes No errors Clear Log..



AASX Package Explorer V3.0 - local file: U:\car.aasx buffered to: C:\Users\Junes\AppData\Local\Temp\tmpxmxnp0.aasx (auxiliary AASX:...

File Workspace Option Help

IDA

Package "U:\car.aasx"

- Env "Environment"
 - Env "AdministrationShells"
 - AAS "CarShell" [https://example.com/ids/aas]
 - Env "All Submodels"
 - Env "ConceptDescriptions"
 - Env "Supplemental files"

Submodel

Submodel element

Submodel element

https://example.com/ids/aas/03
00_6141_5052_8715

https://example.com/ids/asset/2
210_6141_5052_7490

Element Content

AssetAdministrationShell (according IEC63278)

Editing of entities

AAS: Move up Move down Move top Move end Delete

Buffer: Cut Copy Paste above Paste below Paste into

SubmodelRef: Reference to existing Submodel Create new Submodel of kind Te Create new Submodel of kind In

You have opened an auxiliary AASX package. You can copy elements from it!

Copy from existing Submodel: Copy single Copy recursive

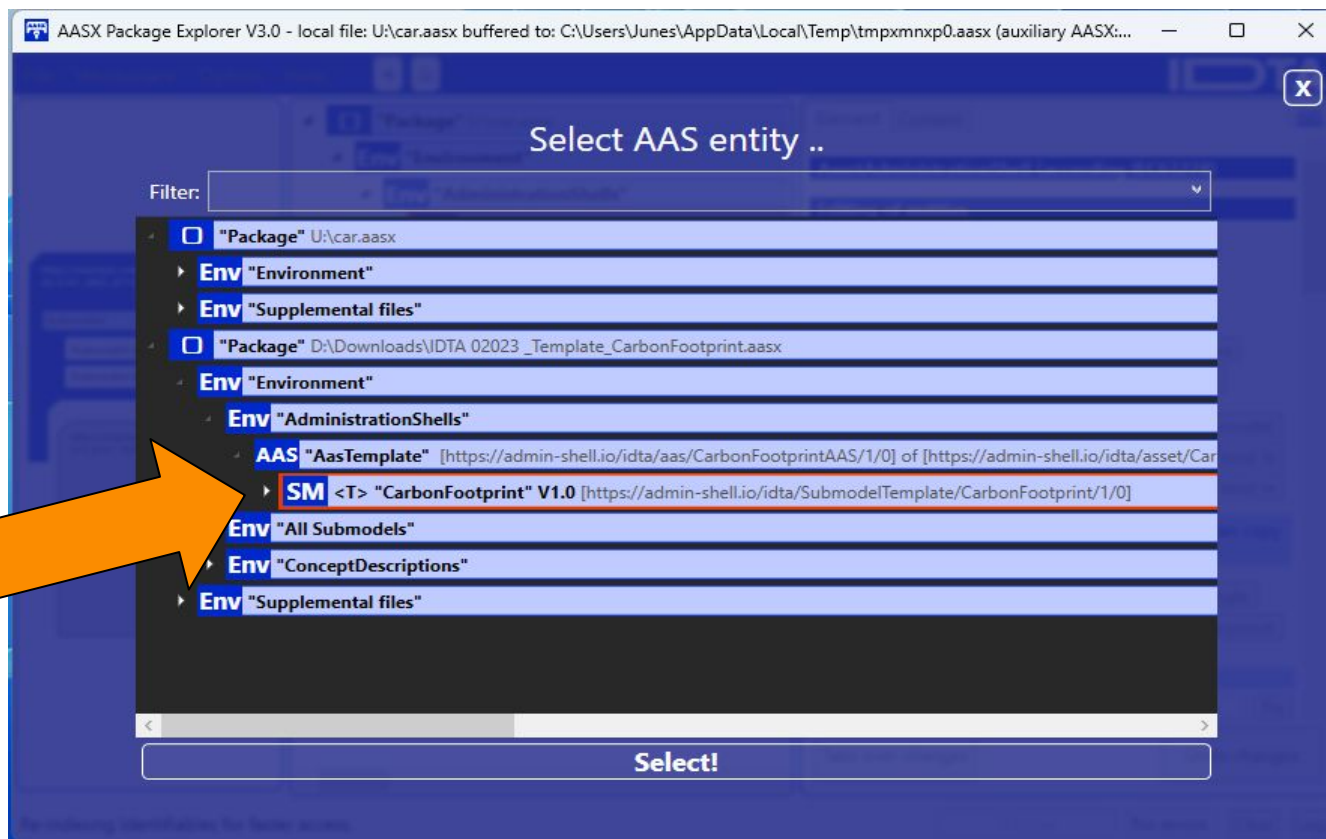
Referable: Copy

idShort: CarShell Fix

Take over changes Undo changes

Re-indexing Identifiables for faster access.

0 bytes No errors Clear Log..



AASX Package Explorer V3.0 - local file: U:\car-contact.aasx buffered to: C:\Users\Junes\AppData\Local\Temp\tmpat51ul.aasx

File Workspace Option Help

IDA

Package "U:\car-contact.aasx"

- Env "Environment"
 - Env "AdministrationShells"
 - AAS "CarShell" [https://example.com/ids/aas]
 - Asset "AssetInformation" [https://example.com/ids/aas/0300_6141_5052_8715]
 - Submodel
 - Submodel element
 - Submodel
 - SM "TechnicalData" [https://example.com/ids/aas/0300_6141_5052_7490]
 - SM "<T> 'ContactInformations'" [https://example.com/ids/aas/0300_6141_5052_7490]
 - Env "All Submodels"
 - Env "ConceptDescriptions"
 - Env "Supplemental files"

Element Content

ConceptDescriptions (missing):

- Create ECLA
- Create this
- Create SMEs

Submodel & -elements:

- Upgrade qualif
- Remove qualifi
- Remove extens
- Fix References

Submodel

Referable:

idShort: ContactInformations Fix

The use of a display name is recommended to express a human readable name for the Referable in multiple languages.

displayName: Create w/ default!

category: v

The use of an description is recommended to allow the consumer of an Referable to understand the nature of it.

Take over changes Undo changes

Re-indexing Identifiables for faster access.

0 bytes No errors Clear Log..

AASX Package Explorer V3.0 - local file: U:\car-contact.aasx buffered to: C:\Users\Junes\AppData\Local\Temp\tmpat51ul.aasx

File Workspace Option Help

Package U:\car-contact.aasx

- Env "Environment"
 - Env "AdministrationShells"
 - AAS "CarShell" [https://example.com/ids/aas/0300_6141_5052_8715]
 - Asset AssetInformation https://example.com/
 - SM "TechnicalData" [https://example.com/]
 - SM "ContactInformations" [https://admin-]
 - CTI Contact information ready
 - FRM Contact Information (IDTA) V1.0 re
 - KNO Known Submodel Templates ready
 - SMC "ContactInformation" (23 elements)
 - Prop "RoleOfContactPerson" = 0173-
 - MLP "NationalCode" → DE @ {Multipl
 - Prop "Language" = de @ {Multiplicity:
 - Prop "TimeZone" = Z @ {Multiplicity=
 - MLP "CityTown" → Musterstadt @ {M
 - MLP "Company" → ABC Company @:
 - MLP "Department" → Vertrieb @ {Mu
 - SMC "Phone" (3 elements) @ {Multipli
 - SMC "Fax" (2 elements) @ {Multiplicity

Submodel

Submodel element

Submodel element

https://example.com/ids/asset/210_6141_5052_7490

Element **Content**

Spec. records:

Add Aspect Add Property

Add Characteristic Add Entity

Add other .. Delete last extension

Known extensions « experimental » :

List of extensions is null! For modelling Submodel template specifications (SMT), a set of particular attributes to the elements of SMTs are specified. These attributes can be added as specific Qualifiers or via adding an extension as a whole.

Known extension:

SMT attributes

Delete last extension

MultiLanguageProperty

Please add multiple languages.

value:

en ABC Company Add blank

valued:

Create data element!

Take over changes

Undo changes

Re-indexing Identifiables for faster access.

No errors Clear Log..

Implementation - Challenges

- there is not much tooling available or tooling often is **not refined** yet
 - current tooling is not beginner friendly
 - **high complexity** due to various standardized concepts
 - trade off between model simplicity and model completeness when modeling complex asset structures
-

Implementation - Best practices

- try to leverage existing tools
 - consider tracking your shells with git
 - make use of already existing submodel-templates
 - when modeling try to model the complete lifecycle
-

Thank you for your attention!

Sources

<https://www.plattform-i40.de/IP/Navigation/DE/Industrie40/WasIndustrie40/was-ist-industrie-40.html>

<https://www.iosb.fraunhofer.de/de/geschaeftsfelder/automatisierung-digitalisierung/digitaler-zwilling-industrie40.html>

<https://www.ipa.fraunhofer.de/de/aktuelle-forschung/kompetenzzentrum-digitale-werkzeuge-in-der-produktion/digital-twin/asset-administration-shell.html>

[https://www.plattform-i40.de/IP/Redaktion/EN/Downloads/Publikation/AAS Reference Modelling.pdf? blob=publicationFile&v=1](https://www.plattform-i40.de/IP/Redaktion/EN/Downloads/Publikation/AAS_Reference_Modelling.pdf?blob=publicationFile&v=1)

https://wiki.basyx.org/en/latest/content/user_documentation/concepts%20and%20architecture/concepts.html
