
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

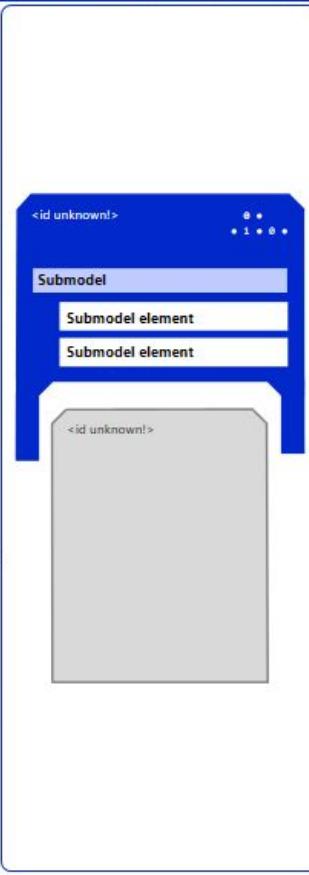
Can be used to check if aas implementations are complying to standards



AASX Package Explorer V3.0 - local file:

IDTA

File Workspace Option Help



∅ No information available

Element Content

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

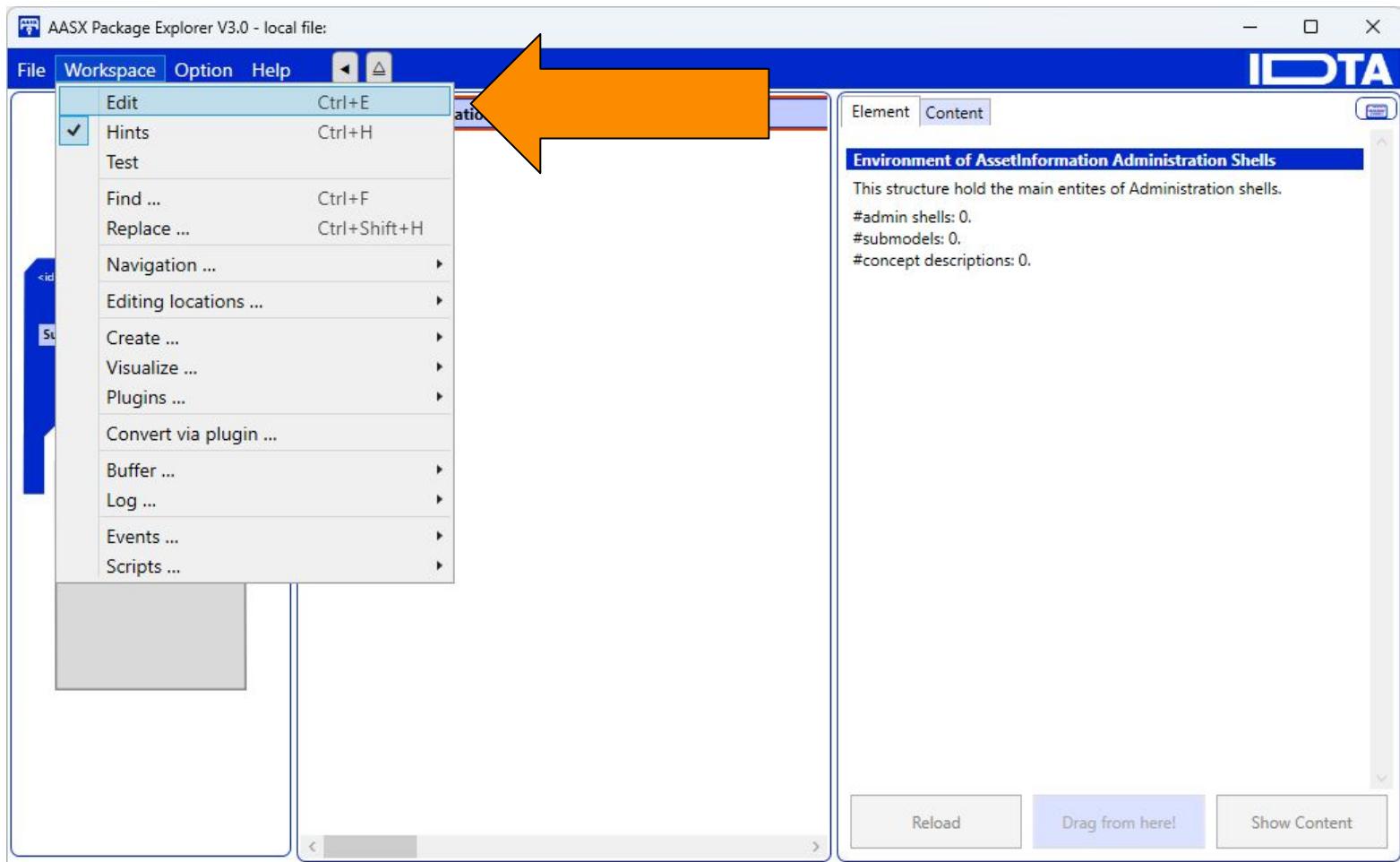
0 bytes

No errors

Clear

Log..

Re-indexing Identifiables for faster access.



AASX Package Explorer V3.0 - local file: **IDTA**

File Workspace Option Help

Element Content

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](#)

Copy: [Copy single](#) [Copy recursively](#) [Copy rec. w/ suppl. files](#) [Paste into](#)

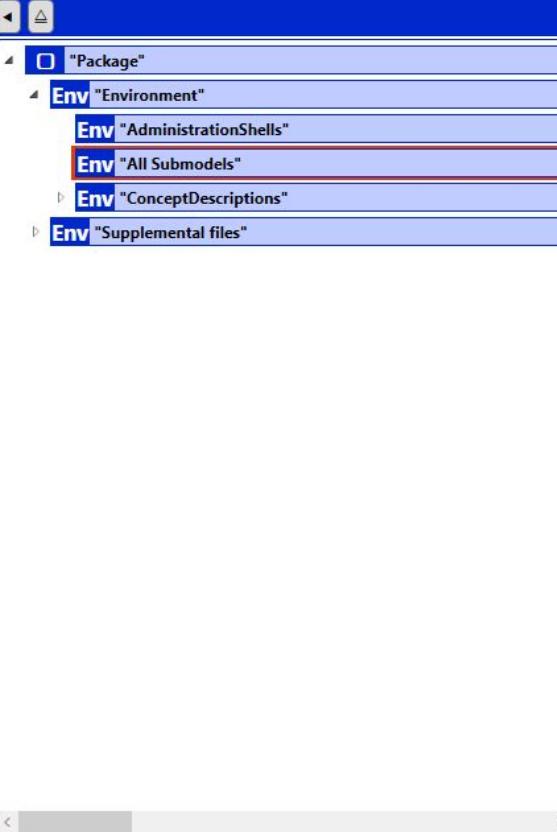
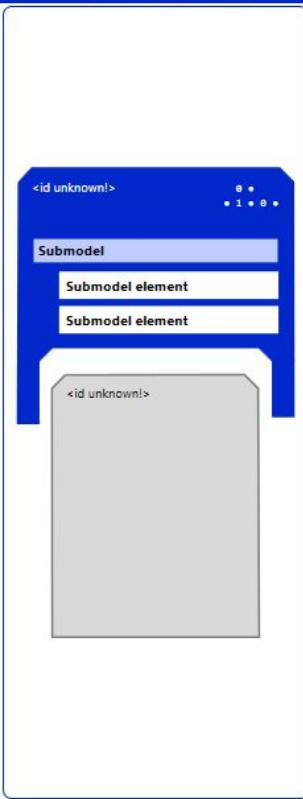
Take over changes Undo changes

0 bytes No errors Clear Log...

Re-indexing Identifiables for faster access.

The screenshot shows the AASX Package Explorer interface. On the left, there's a tree view of a package structure. It includes a main package node, an environment node labeled "Env 'Environment'", and several subnodes under it: "AdministrationShells", "All Submodels", "ConceptDescriptions", and "Supplemental files". The "AdministrationShells" node is highlighted with a red border. On the right, there's a content editor for the environment. It displays a message about the absence of administration shells and provides options to add them. Below this message are buttons for adding entities like "AAS" or "ConceptDescription", and buttons for copying selected items. A large orange arrow points from the bottom center of the screen towards the "Copy" section of the content editor. At the very bottom, a status bar indicates "Re-indexing Identifiables for faster access." and shows system metrics like 0 bytes, No errors, and a log button.

File Workspace Option Help



IDA

Element Content

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.

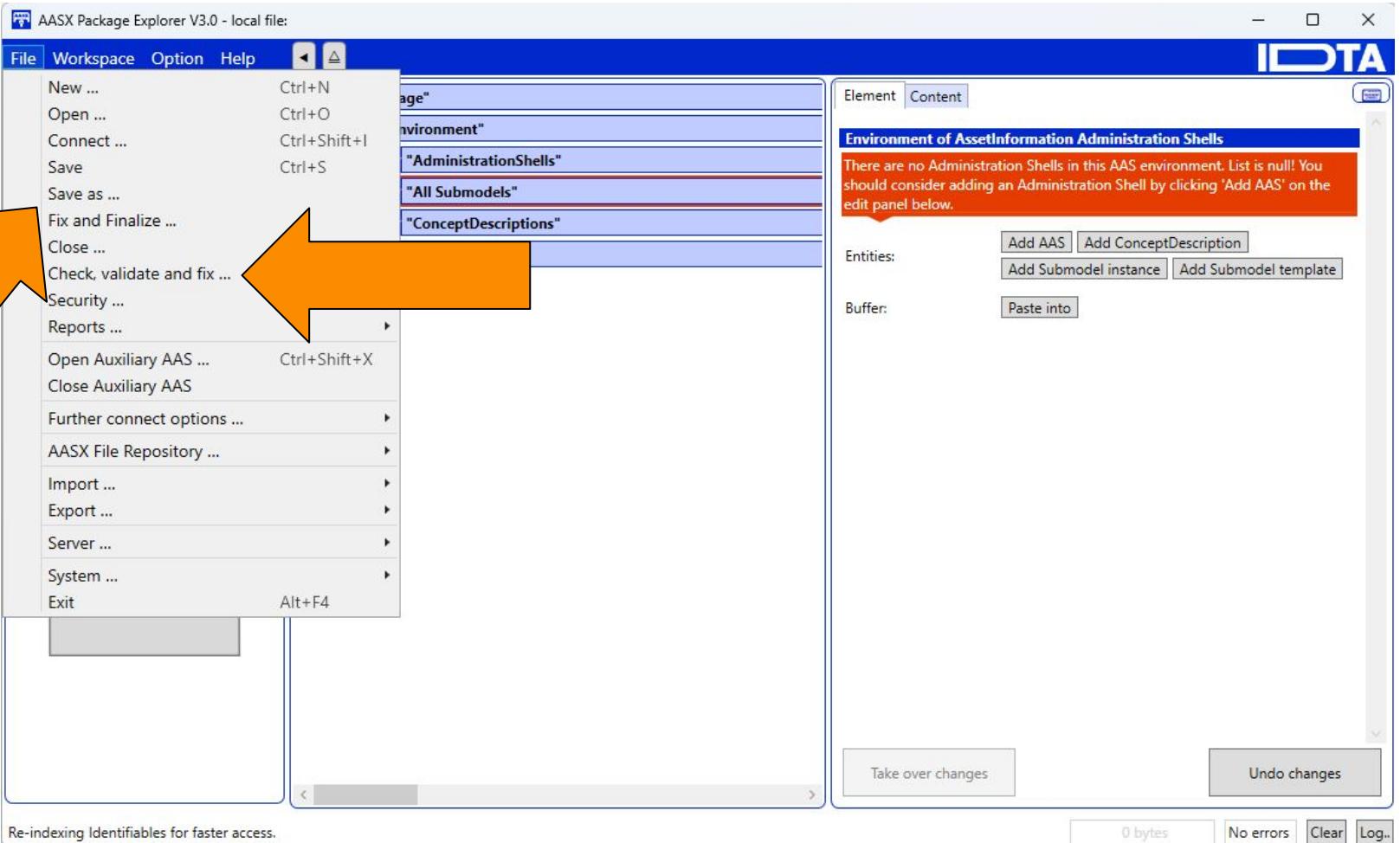
Entities: [Add AAS](#) [Add ConceptDescription](#)
[Add Submodel instance](#) [Add Submodel template](#)

Buffer: [Paste into](#)

Take over changes Undo changes

0 bytes No errors Clear Log..

Re-indexing Identifiables for faster access.



Working with AAS - Tools

Eclipse AASX Package Explorer

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

FA³ST

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

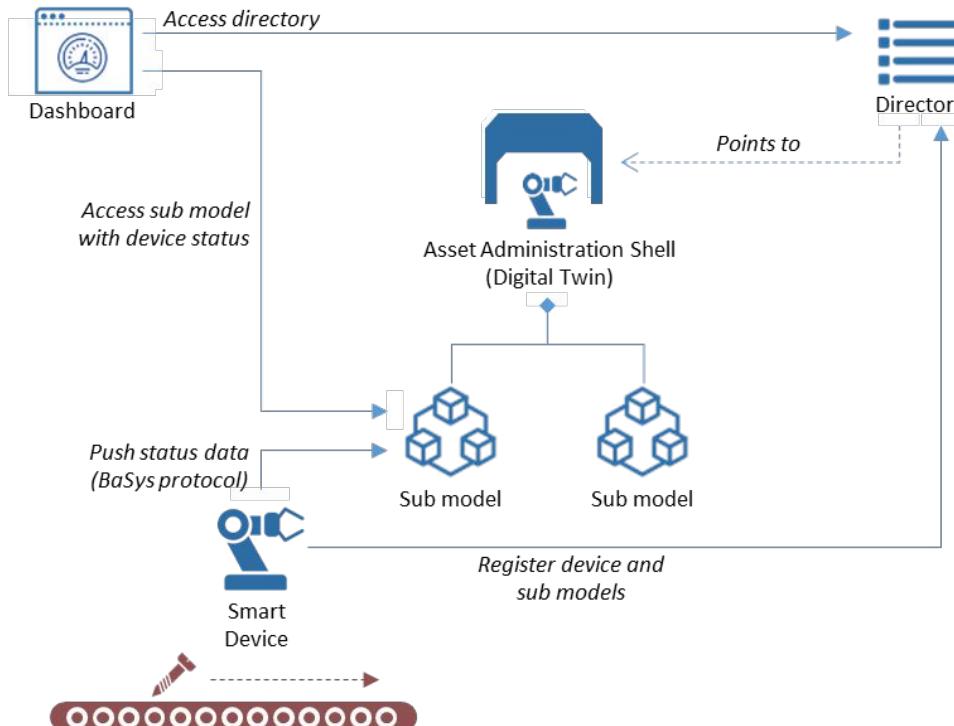
Eclipse Basyx

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

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

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

"r.aasx
nt"
strationShells"
models"
tDescriptions"
tal files"

Element Content

Environment of AssetInformation Administration Shells

Entities:

Add AAS

Add ConceptDescription

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

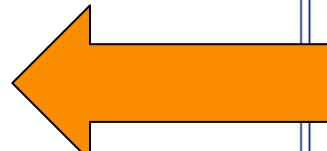
Copy existing AAS:

Copy single

Copy recursively

Copy rec. w/ suppl. files

Paste into



Take over changes

Undo changes

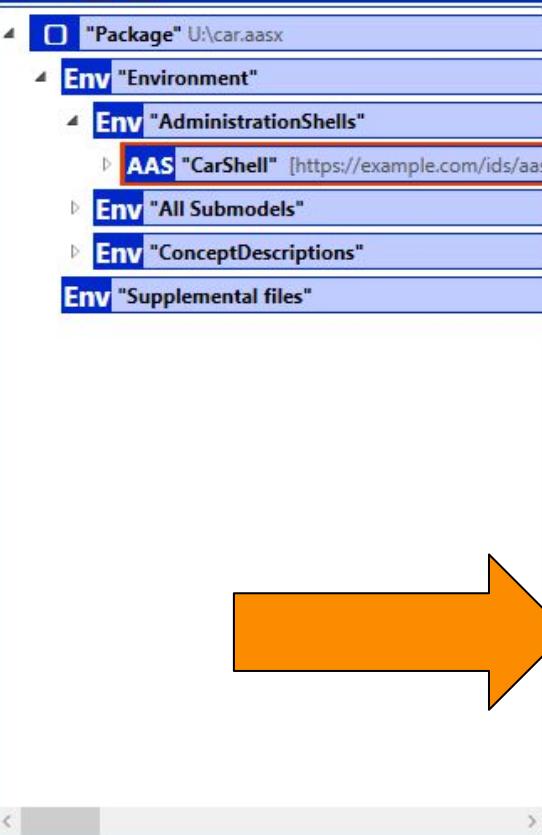
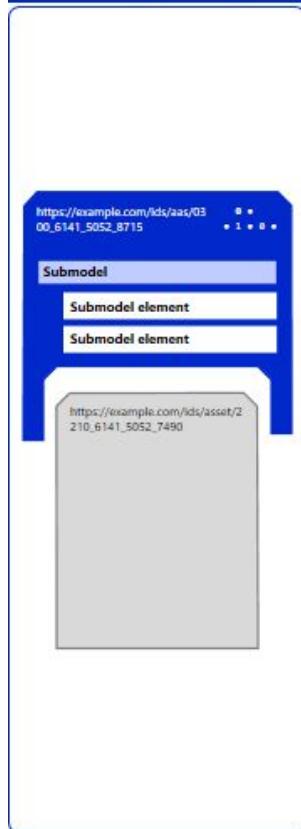
Re-indexing Identifiables for faster access.

0 bytes

No errors

Clear

Log..



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

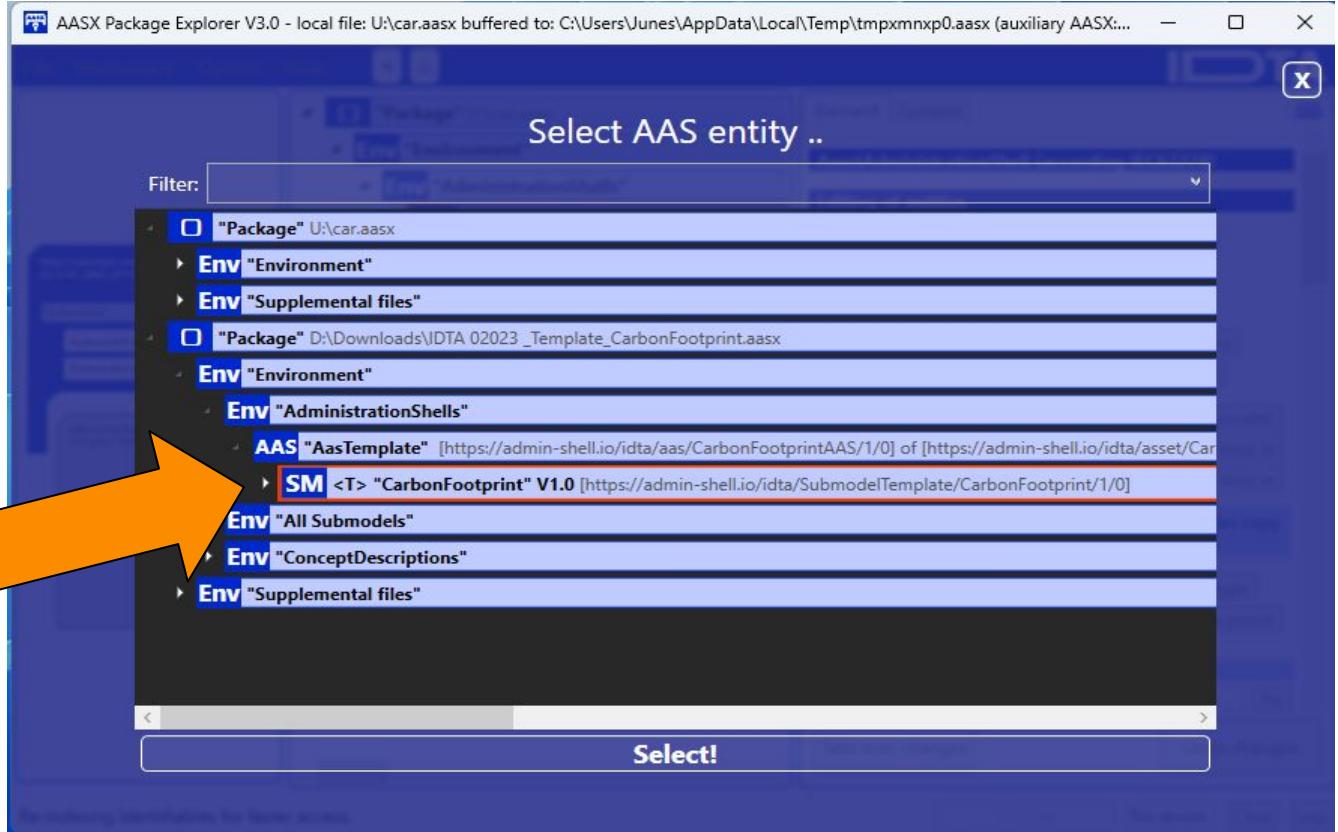
Referable:

idShort: CarShell Fix

Take over changes Undo changes

0 bytes No errors Clear Log..

Re-indexing Identifiables for faster access.



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

IDTA

Re-indexing Identifiables for faster access.

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!

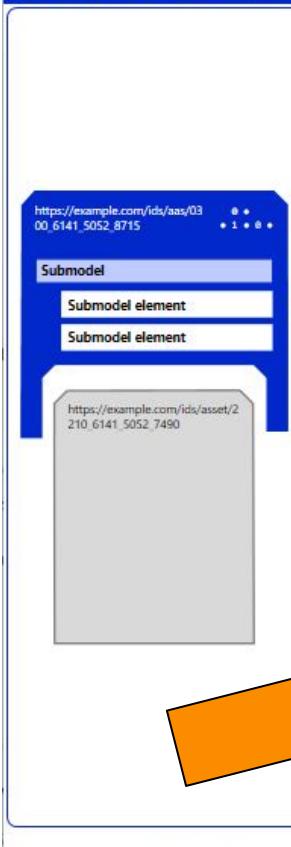
category:

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

0 bytes No errors Clear Log..

The screenshot shows the AASX Package Explorer interface. On the left, there's a preview pane showing a submodel structure with various components like 'AssetInformation', 'TechnicalData', and 'ContactInformations'. A large orange arrow points from this preview area towards the central tree view. The central tree view displays a hierarchical structure of packages and environments, with 'ContactInformations' highlighted under the 'TechnicalData' environment. The right pane provides detailed information for the selected element, including fields for 'idShort' (set to 'ContactInformations'), 'displayName' (set to 'Create w/ default!'), and 'category'. There are also buttons for 'Take over changes' and 'Undo changes' at the bottom of this pane.



<

>

Re-indexing Identifiables for faster access.

- "Package" U:\car-contact.aasx
- Env "Environment"
- Env "AdministrationShells"
- AAS "CarShell" [https://example.com/ids/aas/03 00_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 @{Multiplici...
 - 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

Element Content

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

valueId:

Create data element!

Take over changes

Undo changes

No errors Clear Log...



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