AMSfree

Exchange and exploitation of data from Asset Management Systems using vendor free format

Presentation of the Prototype

CEDR Transnational Road Research Programme / Call 2018
Final Conference May, 24th–25th 2022, Stockholm

Hochschule Karlsruhe
University of
Applied Sciences

INFRASTRUCTURE
MANAGEMENT
CONSULTANTS

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Agenda

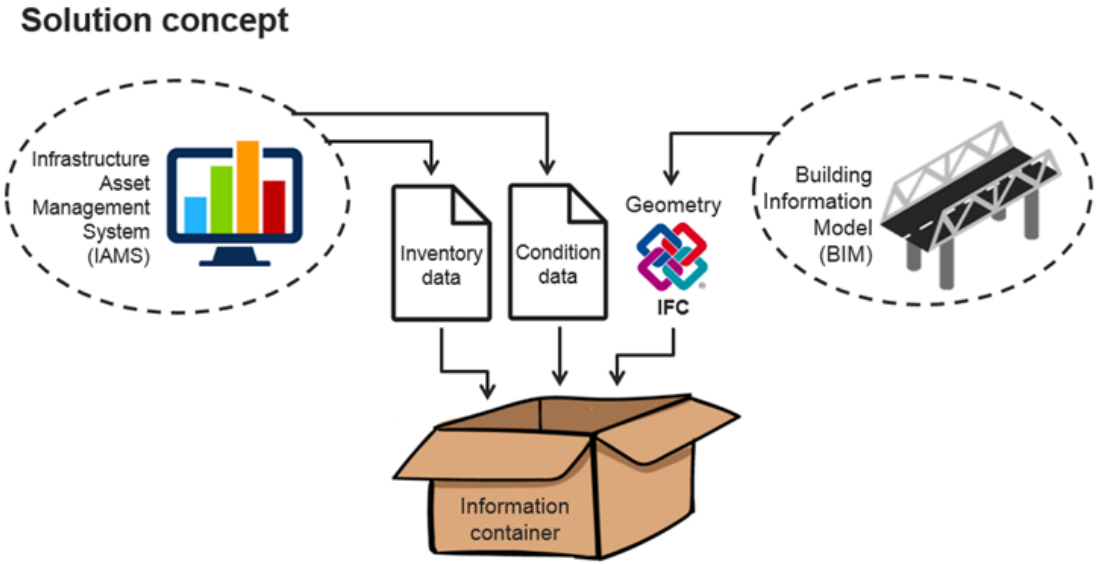
09:15	Introduction	UASKA	5 min
09:20	Poster of the whole Project	UASKA	5 min
09:25	Use Cases including Posters	IMC	15 min
09:40	Prototype	RUB	10 min
09:50	Live Demonstration of the Prototype	RUB / IMC	35 min
10:25	Discussion (Q&A)	all	20 min

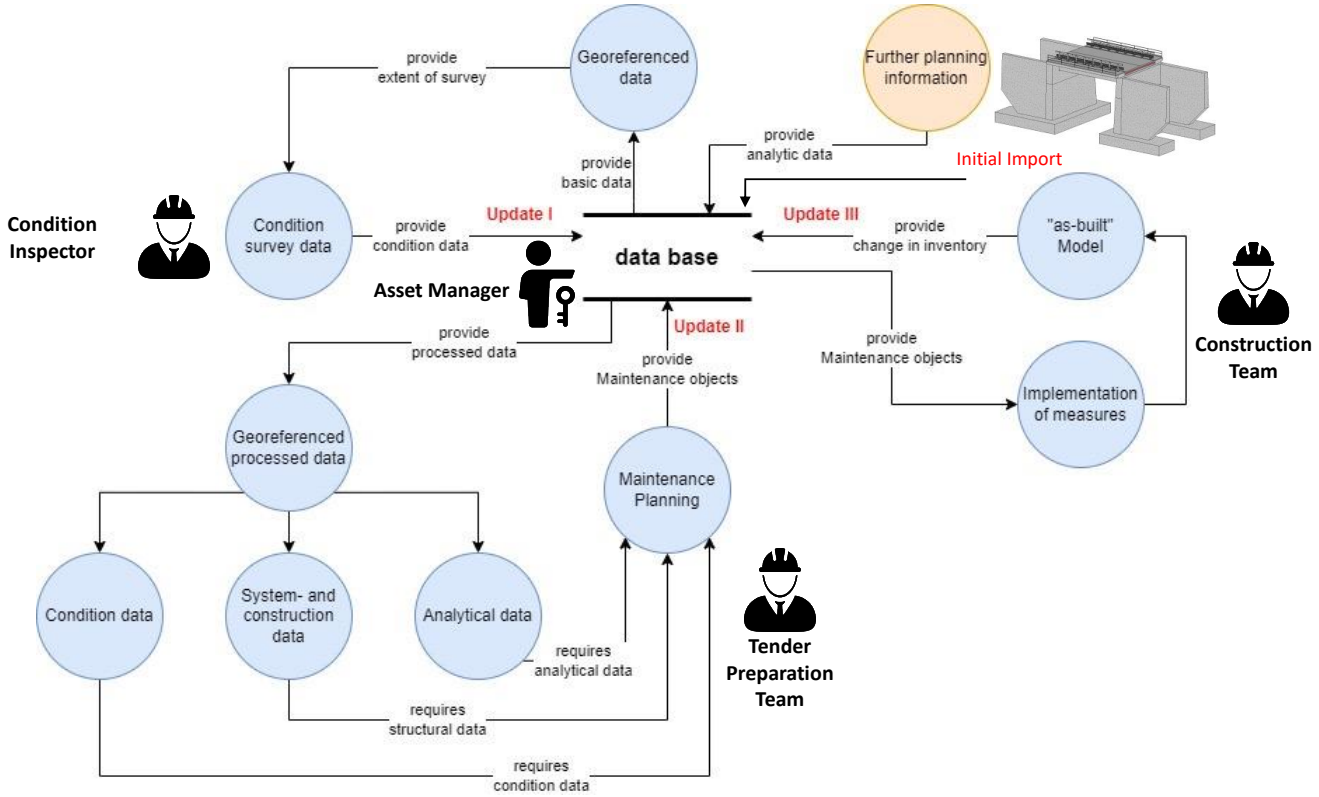
Introduction

Data Management Challenges

- Insufficient data transfer from the construction phase
- Different responsibilities for the management of information
- Decentralized storage and acquisition of information
- Consistency very difficult to maintain because data is stored redundantly
- Uniform access difficult because different vocabularies are used

Introduction




provide
extent of survey
Georeferenced
data
Further planning
information
provide
analytic data
Initial Import
provide
basic data
Condition
Inspector
Condition
survey data
provide
condition data
Update I
Update III
provide
change in inventory
"as-built"
Model
data base
Asset Manager
Construction
Team
Update II
provide
processed data
provide
Maintenance objects
provide
Maintenance objects
Implementation
of measures
Georeferenced
processed data
Maintenance
Planning
Condition data
System- and
construction
data
Analytical data
requires
analytical data
Tender
Preparation
Team
requires
structural data
requires
condition data

Exchange and Exploitation of Data from Asset Management Systems using Vendor Free Format

AMS FREE

Project Summary

The aim of the AMSFree project is to develop a new approach based on information containers to combine asset management systems and BIM. Therefore, the processes and procedures existing within asset management systems as well as the related data flows were analysed and described by using process and data flow models. Three typical use cases were identified, and their data exchange was described. The interoperability and the connection with already existing databases or information systems are considered. Based on the example of a road section and a bridge, the consistency of the BIM concept and the implementation of rights of use are demonstrated. It is shown how existing national data formats (e.g., OKSTRA) for the management of road and bridges are linked to the IFC format during the entire life span. The approach differentiates between data that is directly contained in BIM and data that is linked to external databases.

Introduction

Planning, construction, operation, and maintenance of infrastructure require a significant commitment of both economic and human resources. For a targeted allocation of financial resources determined according to objective criteria, asset management systems (AMS) are used. One of the key aspects of asset management covered by most of these road authorities is the condition evaluation of assets and the assessment of related risks. While the condition-related data and data on inventory and traffic are stored in national asset management databases, data on materials from the maintenance planning and construction phase are often included in BIM models, documented as PDF or hosted in external databases. The exchange and update of these data are often time-consuming and error-prone. To combine the advantages of AMSs and BIM, a methodology based on standardized information containers was developed and tested.

Methodology

Based on the previously described potential to combine AMS with BIM, concepts for the integration of data from AMSs into BIM are introduced. First, the stakeholders within the context of asset management and its processes are described by using a process map. Three relevant update steps were defined on which an asset manager interacts with external contractors such as a inspector, a tender preparation team and a construction team. Based on the process analysis, the related data that needs to be exchanged at each update step and the national data formats are analyzed. The approach involves linking and transferring different data sources, models, or formats. This challenge cannot be solved in a universally valid way. The SWT is used to define ontologies for the description of domain-specific semantic information and link data from different data sources. It is shown how existing national data formats for managing road assets during the whole life span are linked with the IFC format. The approach was tested and validated in the context of use cases.

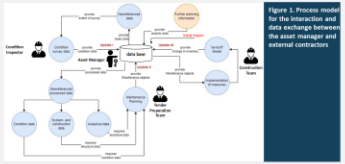


Figure 1. Process model for the interaction and data exchange between the asset manager and external contractors

ICDD Container

A prototype was developed to evaluate the proposed concepts of sharing, exchanging and visualization of data between the asset manager and external contractors by using information containers. The ICDD provides an environment for capturing and linking data from different formats. File-based documents can be linked in this information container. Figure 2 shows the idea of using standardized information containers for the data exchange between an asset manager and external contractors.

Figure 2. Using standardized information Containers for the data exchange between the asset manager and external contractors

Use Cases

Assignment of the 3D Geometry to the Structure Elements
It is essential to consider the finest granularity of the asset management database to be able to link BIM with the different data models. For instance, Germany's ASB-ING's object classification is a hierarchical catalogue with a huge number of object type categories. The model is disassembled, and each bridge element and sub-element is associated with the corresponding ASB-ING catalogue type. The IFC entity types are exemplary shown in Figure 3.

Figure 3. Disassembled bridge model with its elements associated with the corresponding objects from the ASB-ING catalogue

1. Inspection
As part of the structural inspections for engineering structures, condition changes to the infrastructure objects are recorded in the asset management database. Update 1 as shown in Figure 1 includes the implementation of results of visual inspections into BIM. The condition of the infrastructure objects and their individual elements can be integrated into BIM.

2. Maintenance Plan
Update 2 includes the implementation of results of maintenance planning into BIM. One can then access specified data for type of maintenance measure, the timeframe, estimated costs and the cause for maintenance activity. Also, bundles of measures, which contain several assets, can be combined and exported together for the program planning and processed correspondingly.

3. Maintenance Measures
Update 3 includes the implementation of an updated "as-built" model into BIM. As a result of the documentation of the construction work achieved, it includes all properties of the maintained elements of a bridge/road section.

Conclusion

In this project a new approach based on information containers was presented to combine AMSs and BIM. The processes and procedures existing within AMSs as well as the related data flows were analyzed. Afterwards, typical use cases were identified, and their data exchange was described. The interoperability and the connection with already existing databases or information systems were considered. Based on the example of a road section and a bridge, the consistency of the BIM concept is demonstrated. It is shown how existing national data formats for the management of road and bridges are linked to the IFC format during the entire life span. The approach differentiates between data that is directly contained in BIM and data that is linked to external databases. The benefits of connecting asset management processes with BIM are enormous. The combination and visualization of material related data within BIM its temporal classification and precise localization offer the possibility for a multitude of new analysis.

Acknowledgements

The authors gratefully acknowledge CEDR (Conference of European Directors of Roads) for funding this research. We would like to thank the consortium of the project AMSFree for their collaboration in the research of BIM-based AM concepts for roads and bridges.

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Prototype:
https://icdd.vm.rub.de/amsfree

Project Website:
http://www.amsfree.eu

Use Cases

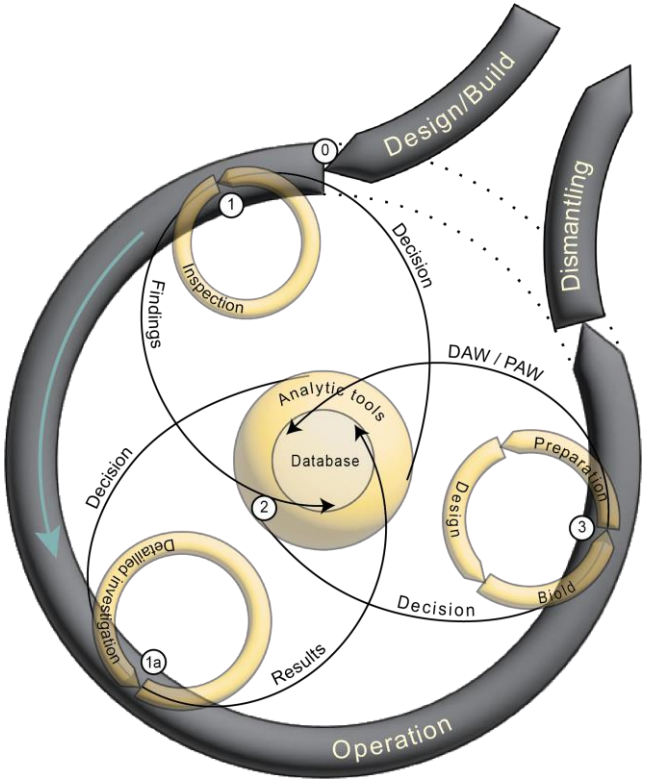
Use Cases

Two assets:

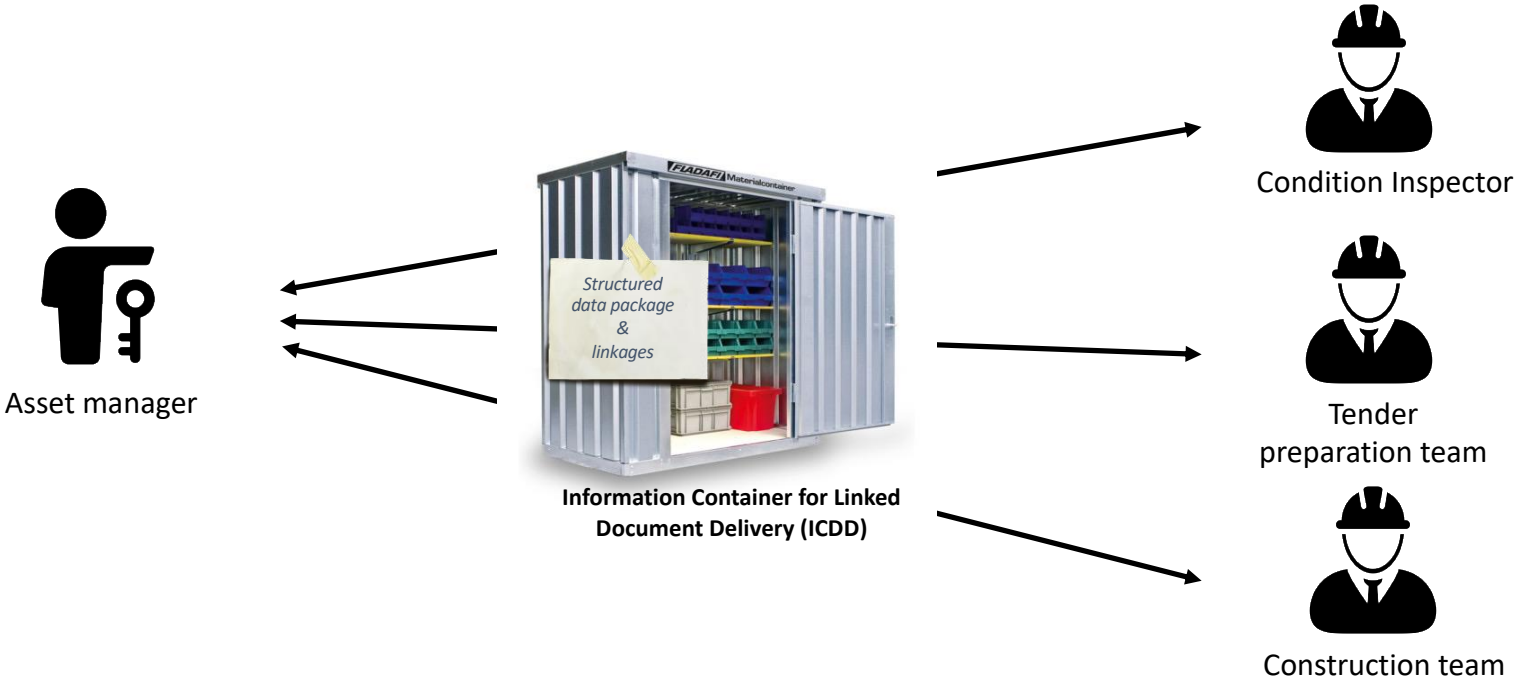
1. one road section
2. one bridge

Three update steps:

1. Inspection
2. Maintenance Plan
3. Maintenance Measures



Use Cases


Asset manager
Structured data package & linkages
Information Container for Linked Document Delivery (ICDD)
Condition Inspector
Tender preparation team
Construction team

Use Cases


ICDD Platform
AMS FREE
Use Case 1 – Inspection
Data Exchange by Using ICDD
Exchange and Exploitation of Data from Asset Management Systems using Vendor-free Format
Activities for Inspection
Realization of the Data Collection and Exchange with the ICDD Prototype


ICDD Platform
AMS FREE
Use Case 2 – Maintenance Plan
Data Collection by Using ICDD
Exchange and Exploitation of Data from Asset Management Systems using Vendor-free Format
Activities for Maintenance Plan
Realization of the Data Collection and Exchange with the ICDD Prototype

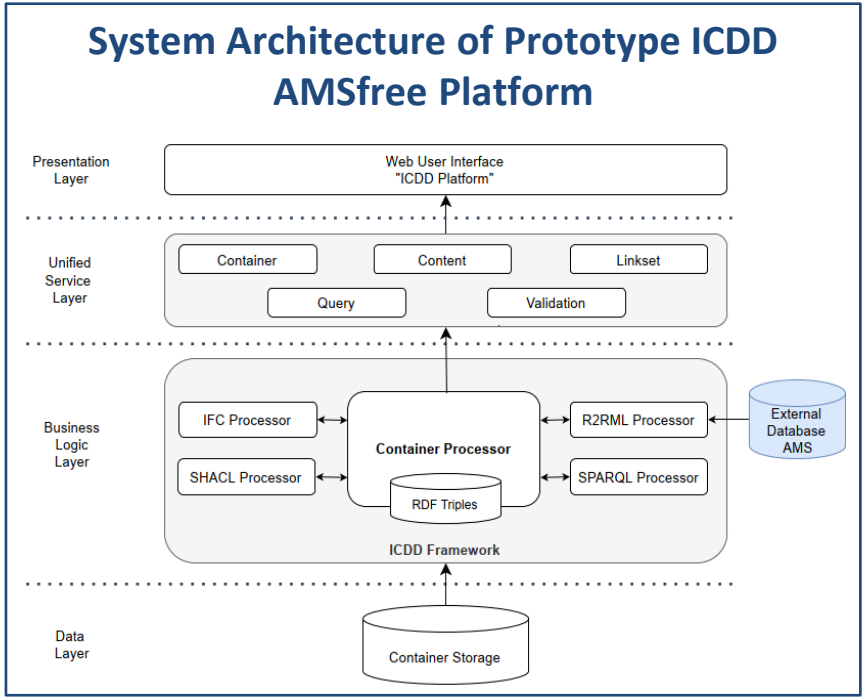

ICDD Platform
AMS FREE
Use Case 3 – Maintenance Measures
Connection with Existing Databases by Using ICDD
Exchange and Exploitation of Data from Asset Management Systems using Vendor-free Format
Activities for Maintenance Measures
Realization of the Data Collection and Exchange with the ICDD Prototype

Prototype

Prototype AMSfree Platform

System Description

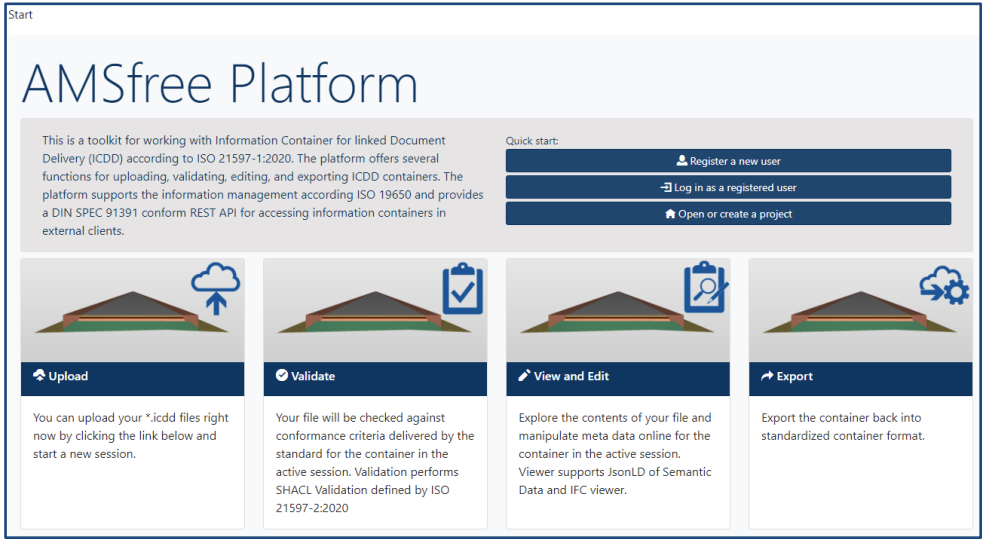
- Based on ICDD Standard ISO 21597
- Data Layer – ICDD as a unit of information storage
- Business Logic Layer – Processing of the Linked Data, BIM model and data of external databases (IAMS)
- Unified Service Layer – functions of container creation, edition, querying, and validation
- Presentation Layer – web user interface



WP 7 Prototype ICDD – AMSfree Platform

User interface and functions

- Project-related management of the containers
- Edition of container content
- Connection with external databases
- Querying of container content



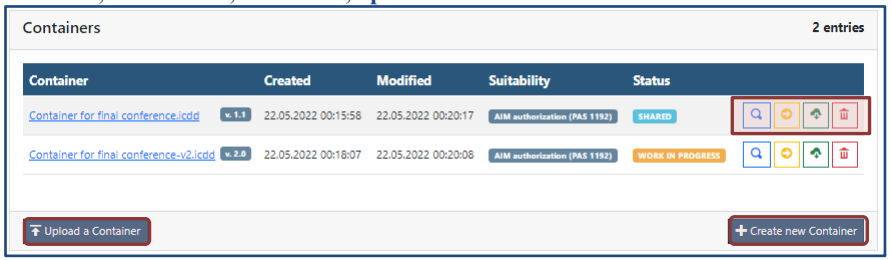
WP 7 Prototype ICDD – AMSfree Platform

Project-related management of containers

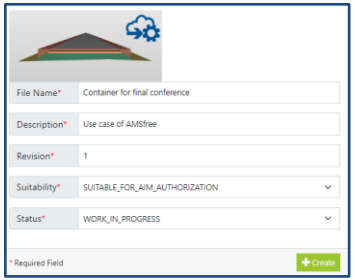
- Creation of project
- Management of containers in the project
  - Create a container with meta information
  - Inherit a container as a new version
  - Download or upload a container
  - Delete

Creation of project

Creation, inheritance, download, upload and cancel of container



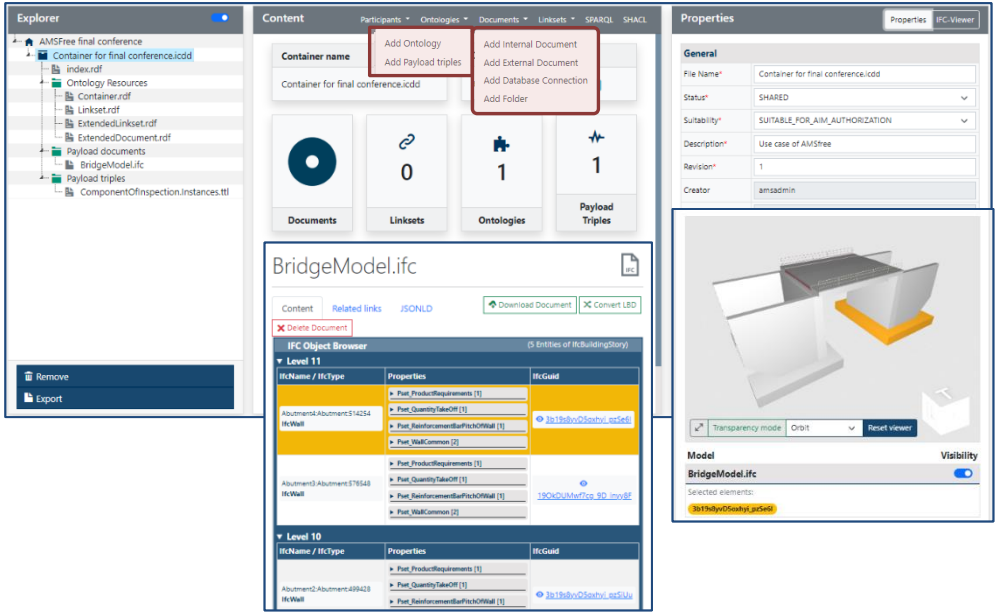
Meta data of container



WP 7 Prototype ICDD – AMSfree Platform

Edition of container content

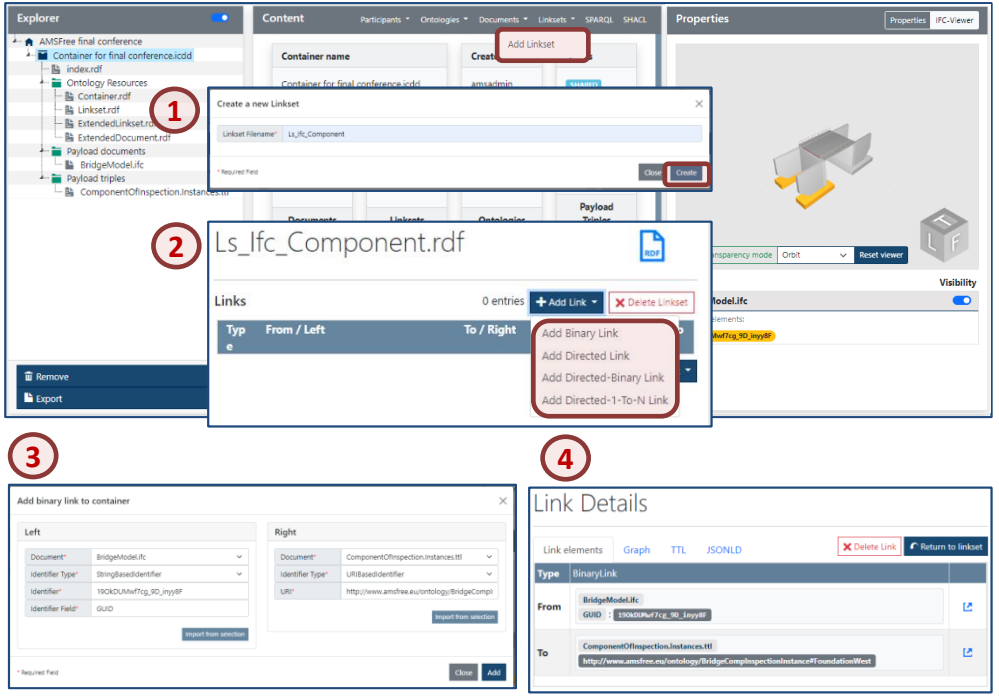
- Preparation of the container structure based on ISO 21597
- Display of dashboard, document metadata, content, and BIM model
- Adding different data
  - Domain ontologies
  - Documents
  - Datasets based on ontologies



WP 7 Prototype ICDD – AMSfree Platform

Edition of container content

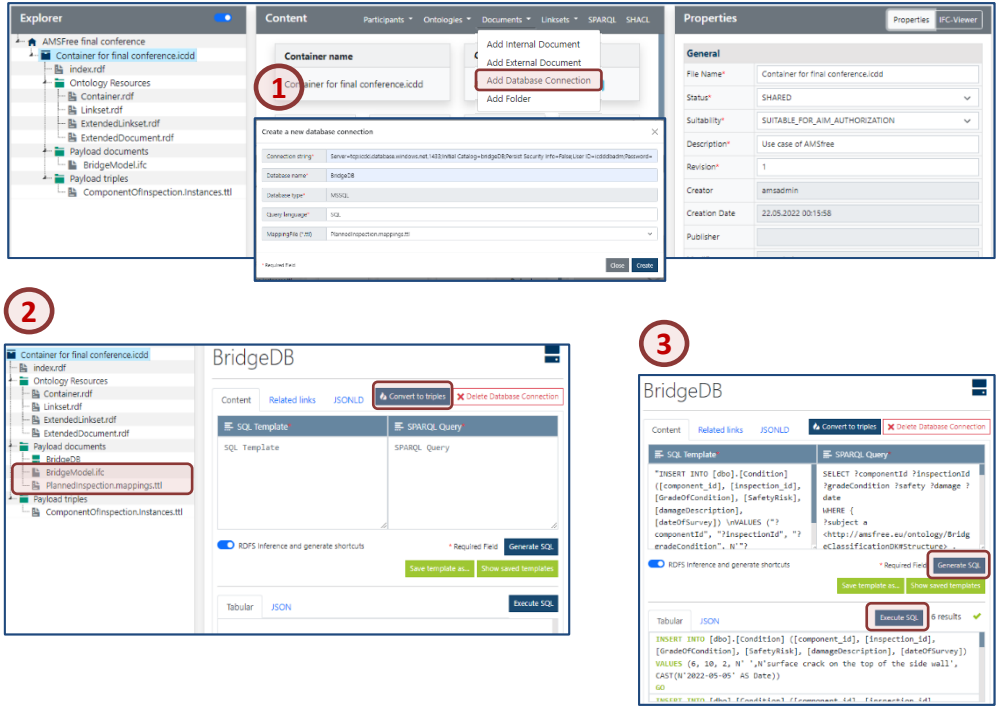
- Adding links between documents and data
  1. Define a linkset file
  2. Select a link type provided by setting links
  3. Set the document and an identifier for the link element
  4. View the detail of link



WP 7 Prototype ICDD – AMSfree Platform

Connection with external databases

1. Add existing database with access data and mapping files
2. Export data into the container as semantic datasets
3. Import data into the database using SQL – SPARQL query templates

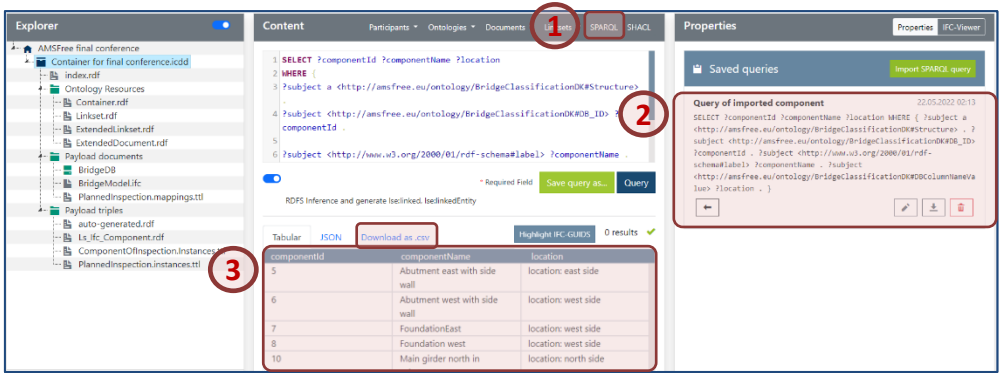


WP 7 Prototype ICDD – AMSfree Platform

Querying of container content

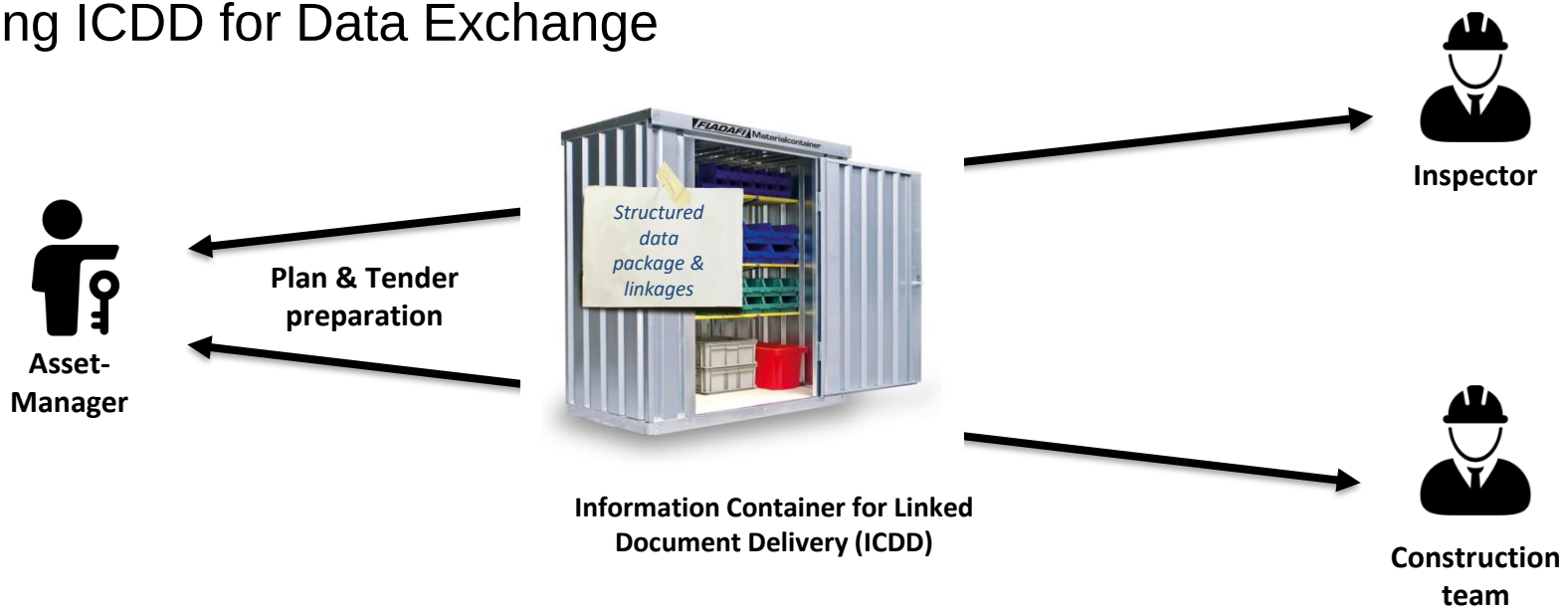
based on SPARQL query language

1. Using implemented SPARQL panel
2. Save query templates
3. Show the query results and download as a .csv file

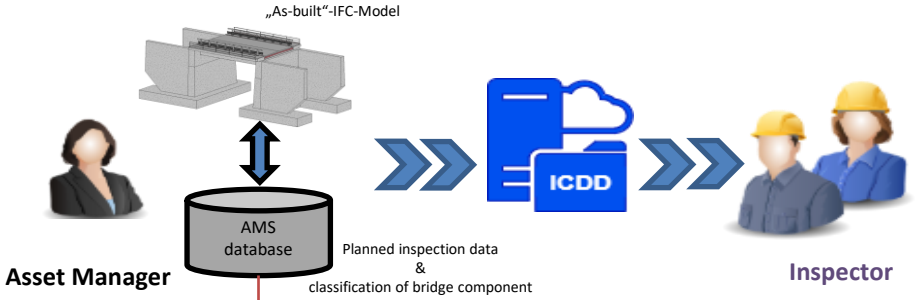


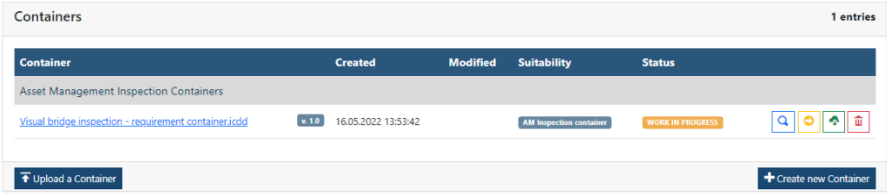
Live demonstration of the prototype

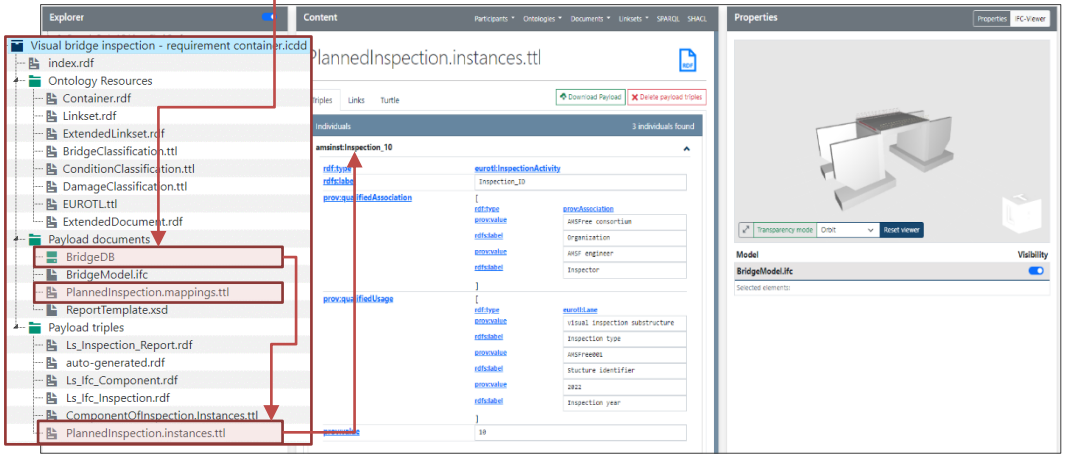
Using ICDD for Data Exchange



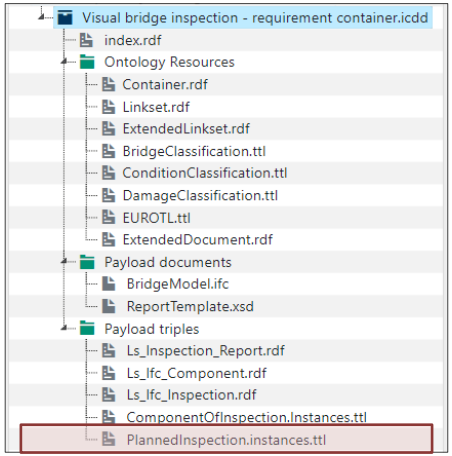
Bridge inspection – Order



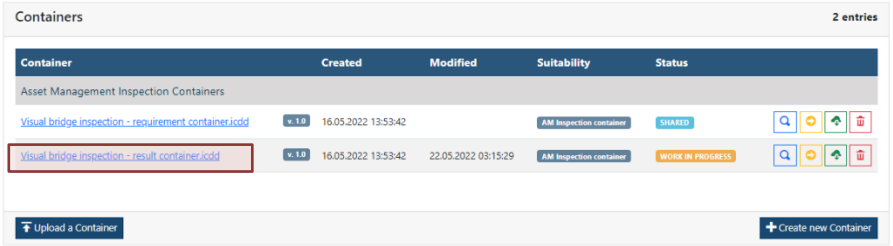


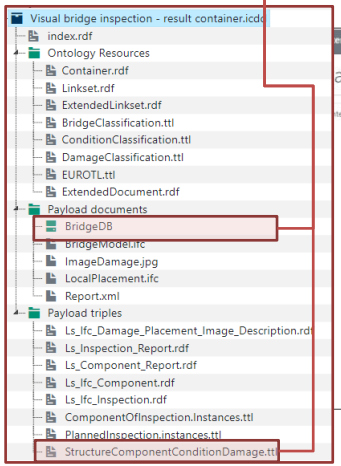


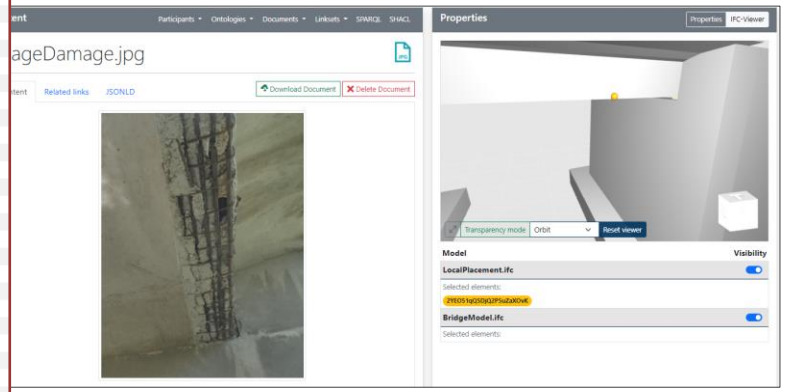
The container delivered to the inspector without DB connection

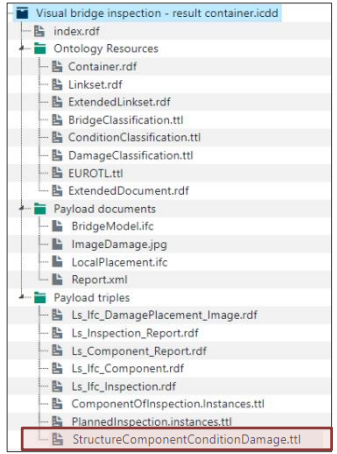


Bridge inspection – Result



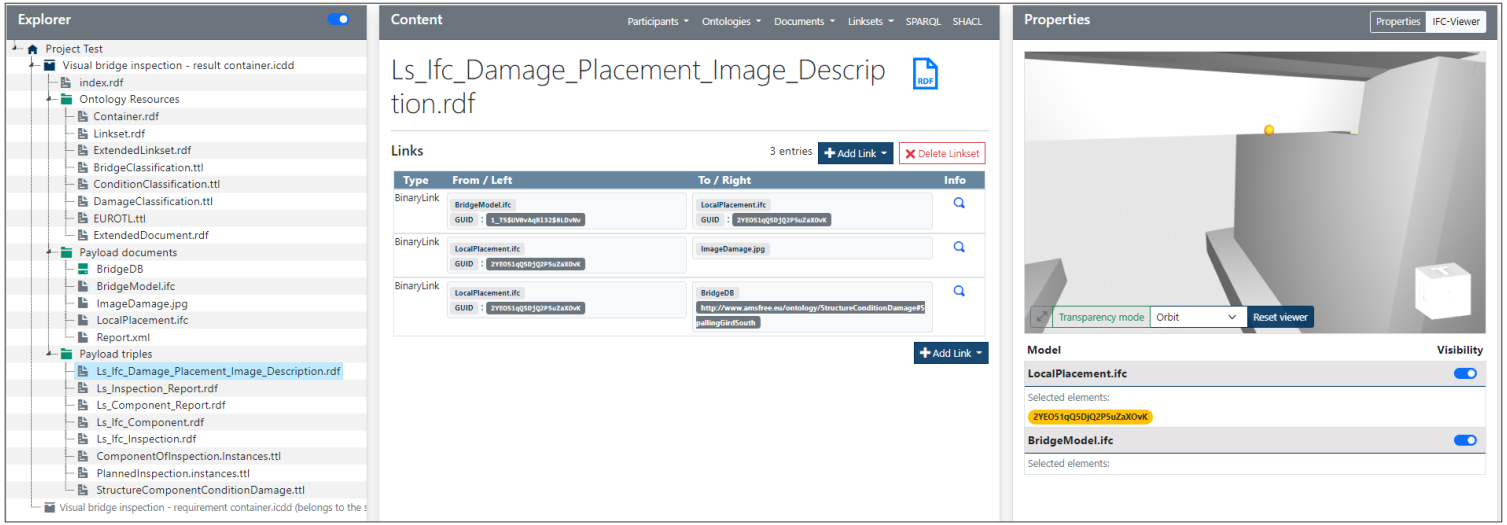




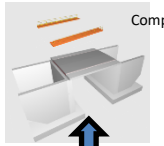


Demonstration on the result container of bridge inspection

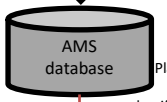
- Overview inspection documents and data
- Check damage with links
- Check results using a query
- Import condition data into the database



Bridge maintenance – Order



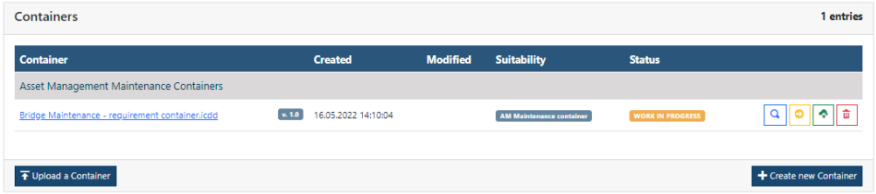
Components to be maintained
&
„As-built"-IFC-Model

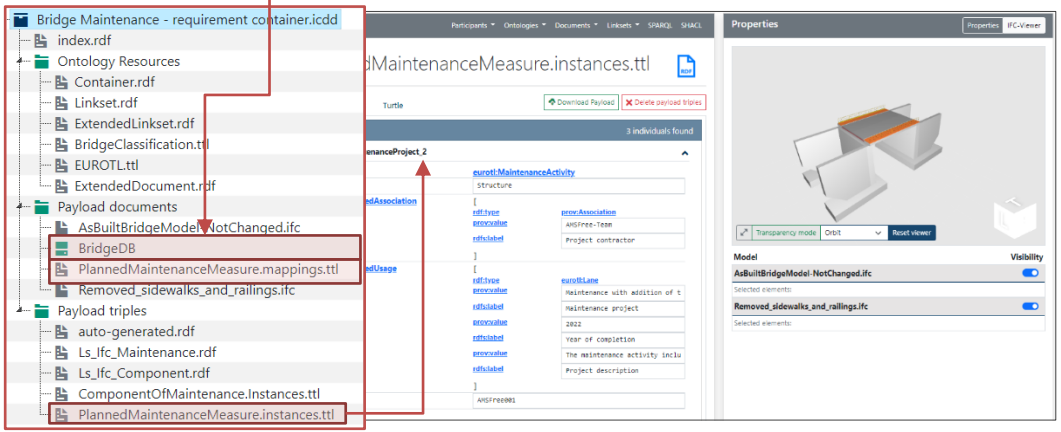


Asset Manager

Planned maintenance data
&
classification of bridge component

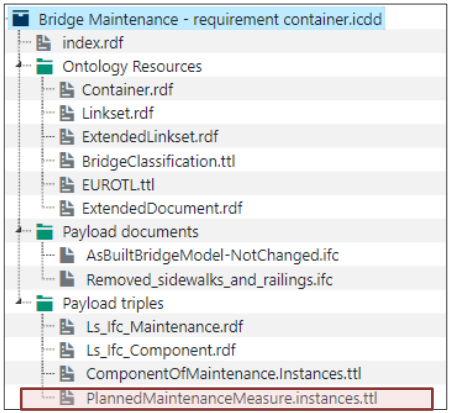
Construction team





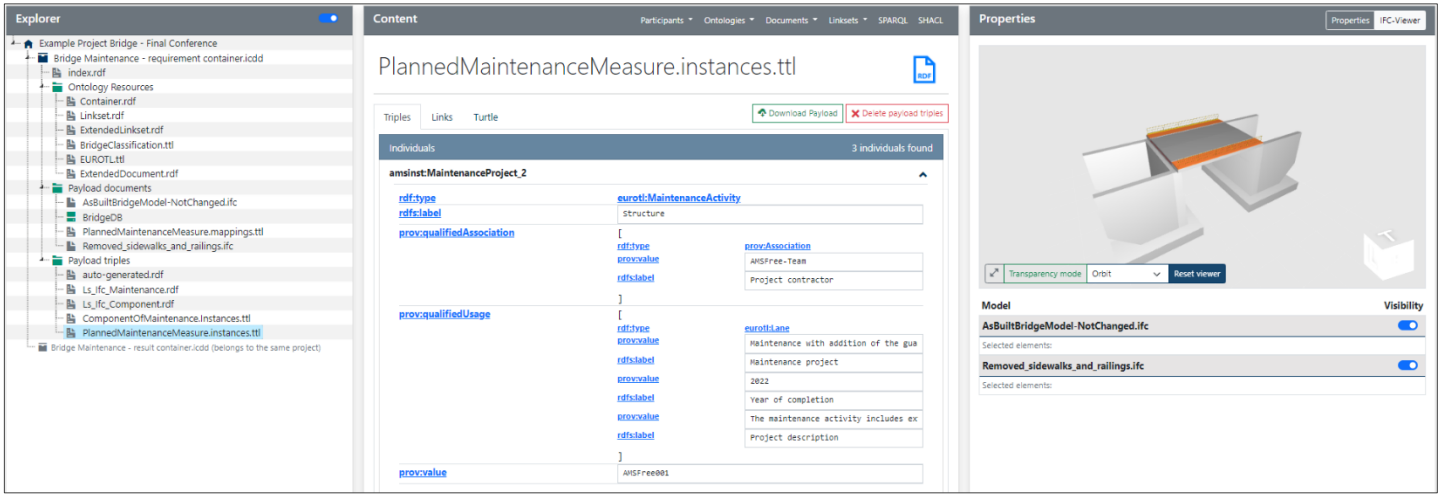
The container delivered to the construction team

without DB connection

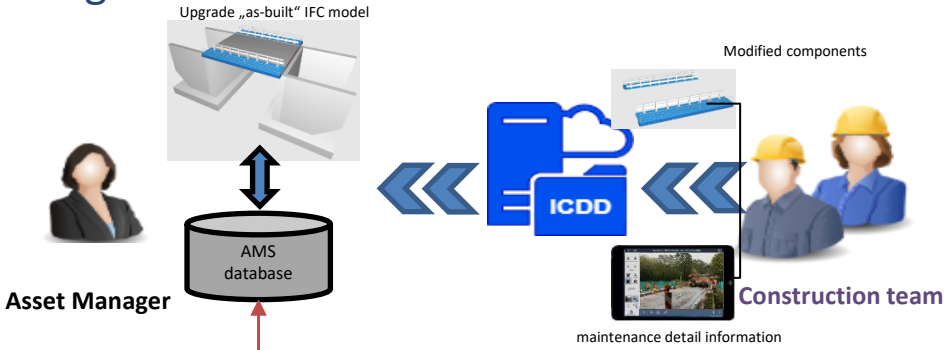


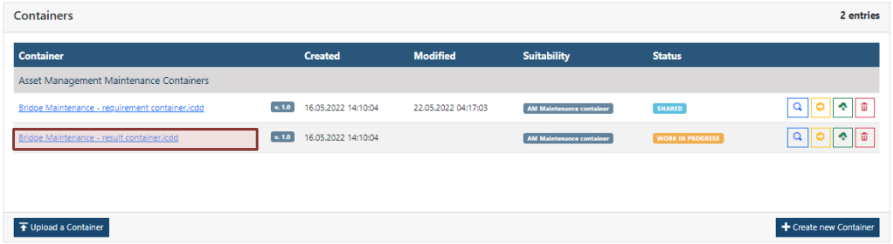
Demonstration on the order container for bridge maintenance

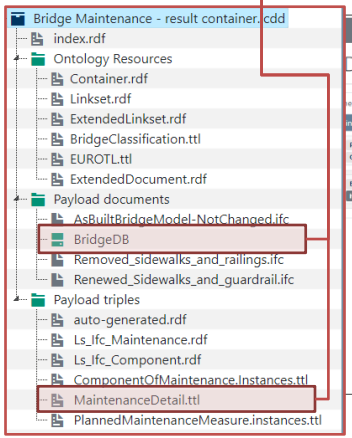
- Overview of the removed structure elements
- Export the data of the planned maintenance project from the database
- Create the link between the IFC model and the maintenance project

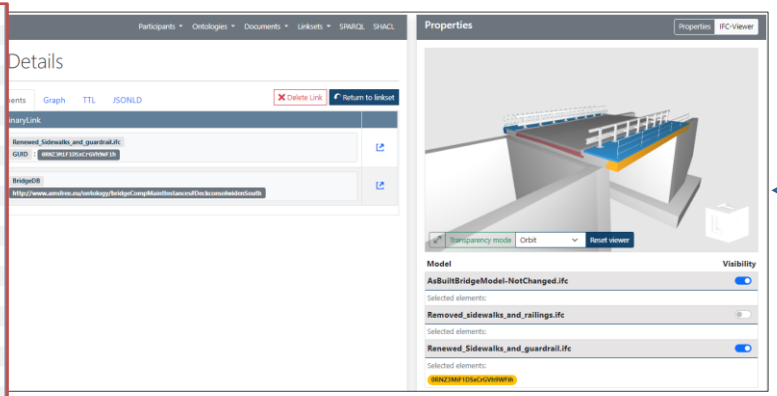


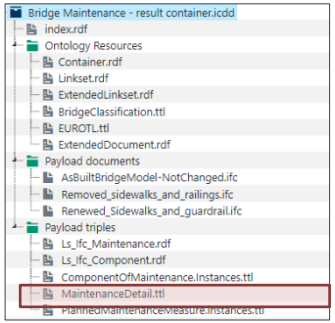
Bridge maintenance – Result





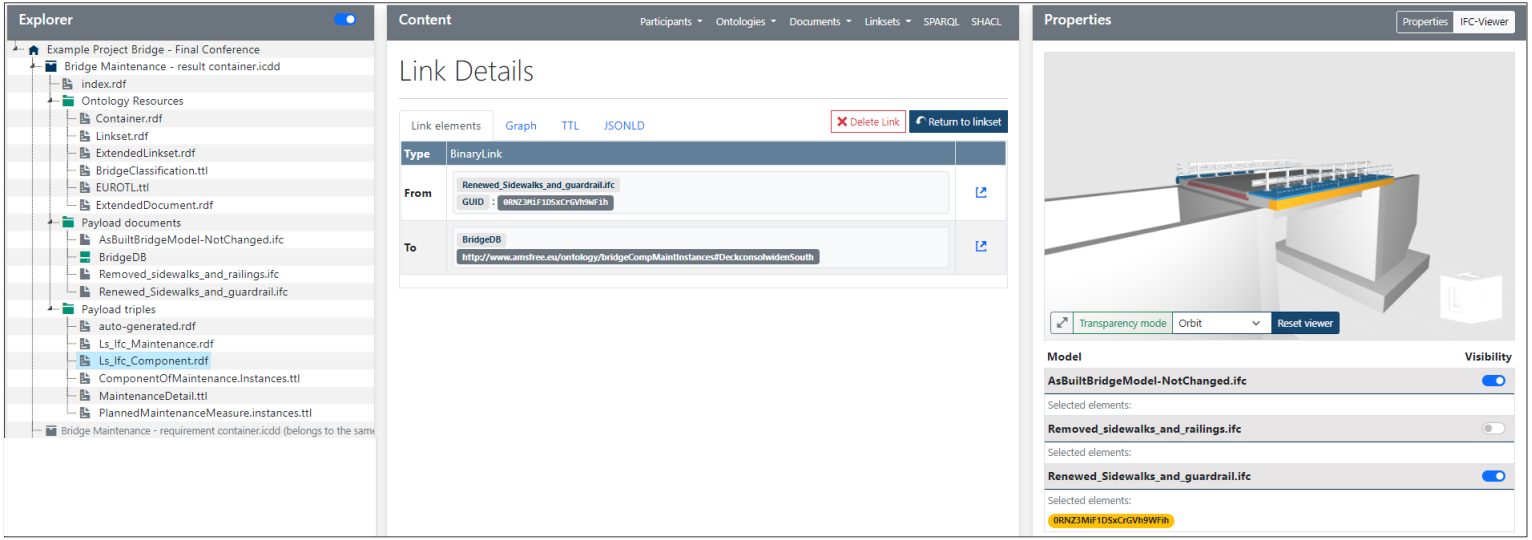






Demonstration on the result container for bridge maintenance

- Overview of new construction elements on the model
- Check results of construction using a query
- Import the changed elements data into the database



Conclusion of use cases for bridge

The technical approach to data preparation and exchange :

- Required information as ontology-based data collected by a contractor
- Changed model provided by a contractor
- Necessary domain ontology provided by asset manager
- As-built model provided by asset manager
- Planned activities as semantic data from IAMS

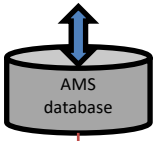
Short introduction of use cases for pavement

- the ICDDs prepared for self-testing

Pavement inspection

Virtuel layer for inspection sections
&
„As-built"-IFC-Model

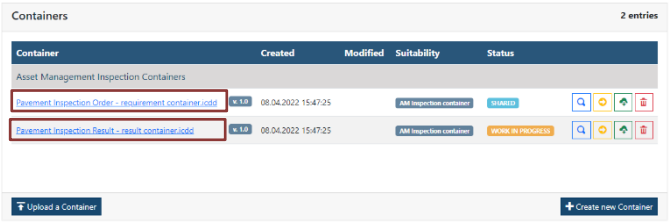
Asset Manager

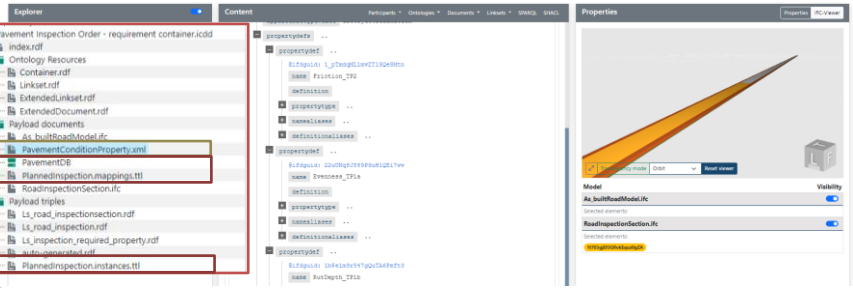


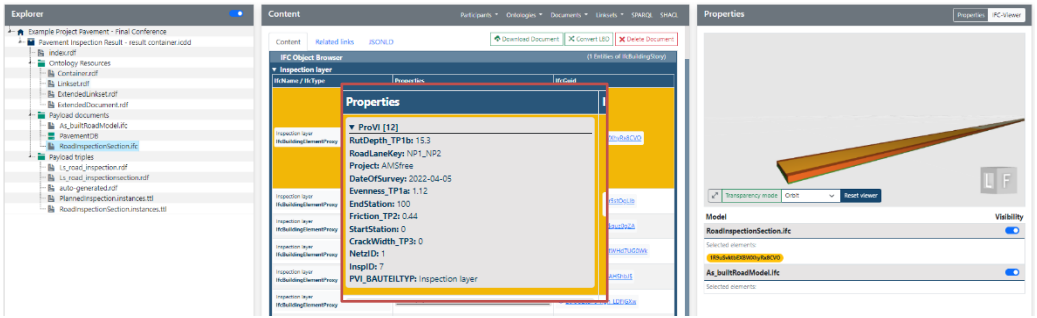
Inspector

Required information
as properties

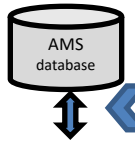
Planned inspection data

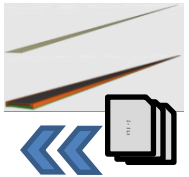






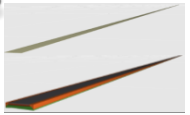
Asset Manager





Condition data as IFC properties

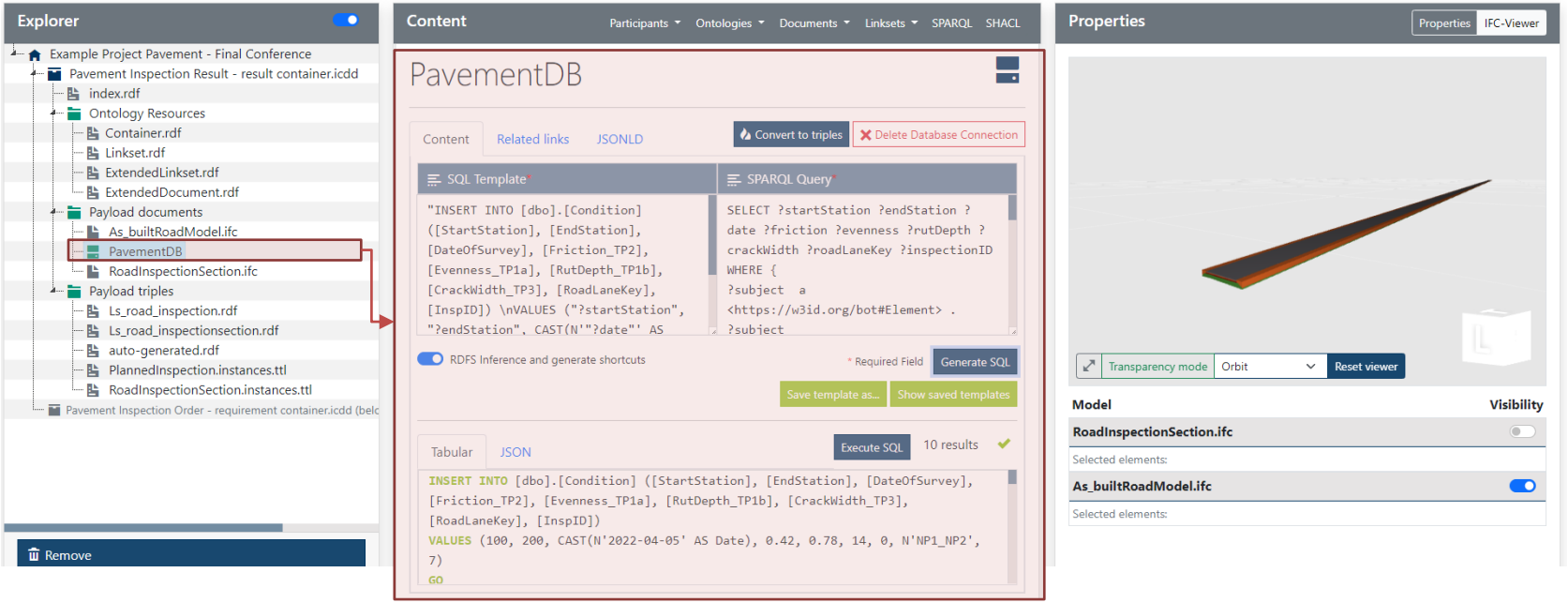
Inspector



Updated „As-built"-IFC-Model

Pavement inspection result

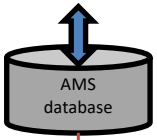
- Check condition assessment
- Import the condition data into the database



Pavement maintenance measure

Pavement section to be maintained
&
„As-built"-IFC-Model

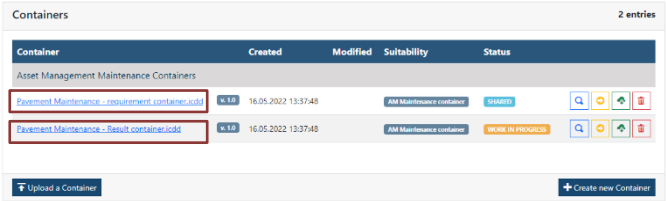
Asset Manager

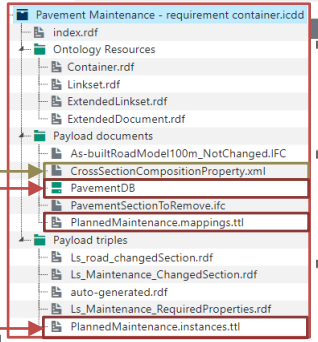


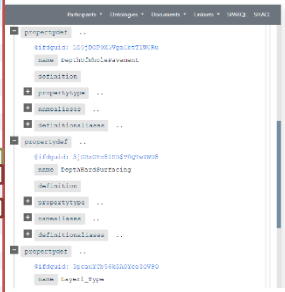
Required information
as properties

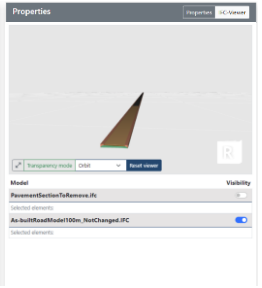
Construction team

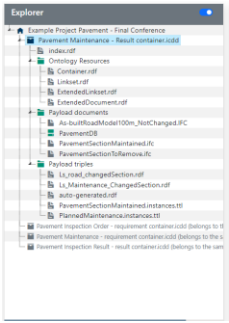
Planned maintenance data

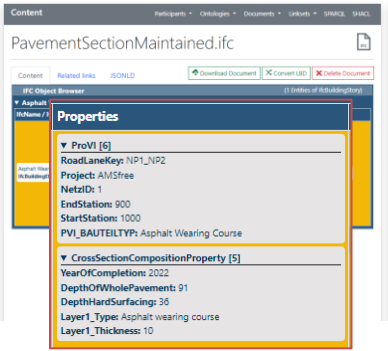


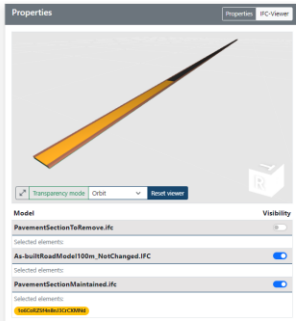






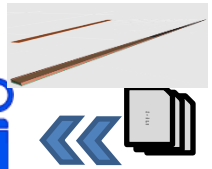






Asset Manager

Updated „As-built"-IFC-Model

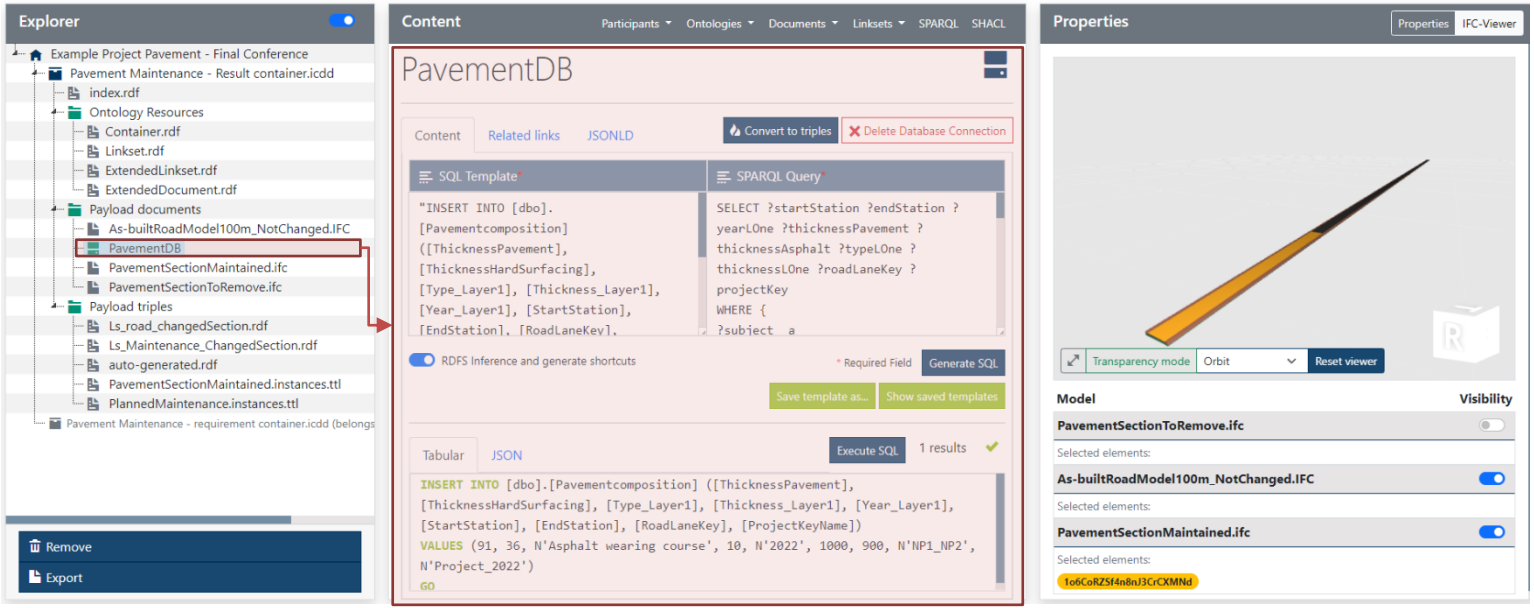


Modified composition data
as IFC properties

Construction team

Pavement maintenance measure

- Check the modified section and related data
- Import the changed composition data into the database



Conclusion of use cases for pavement

The technical approach to data preparation and exchange:

- Required Data as property set template provided by asset manager
- Planned activities as semantic data from IAMS
- IFC-Model provided by asset manager
- Enriched IFC-Model with properties by a contractor

Q&A

AMS
FREE

THANK YOU FOR YOUR ATTENTION!