Proposal for the integration of a Building Material part: (ISO 19152-7) within the Land Administration Domain Model

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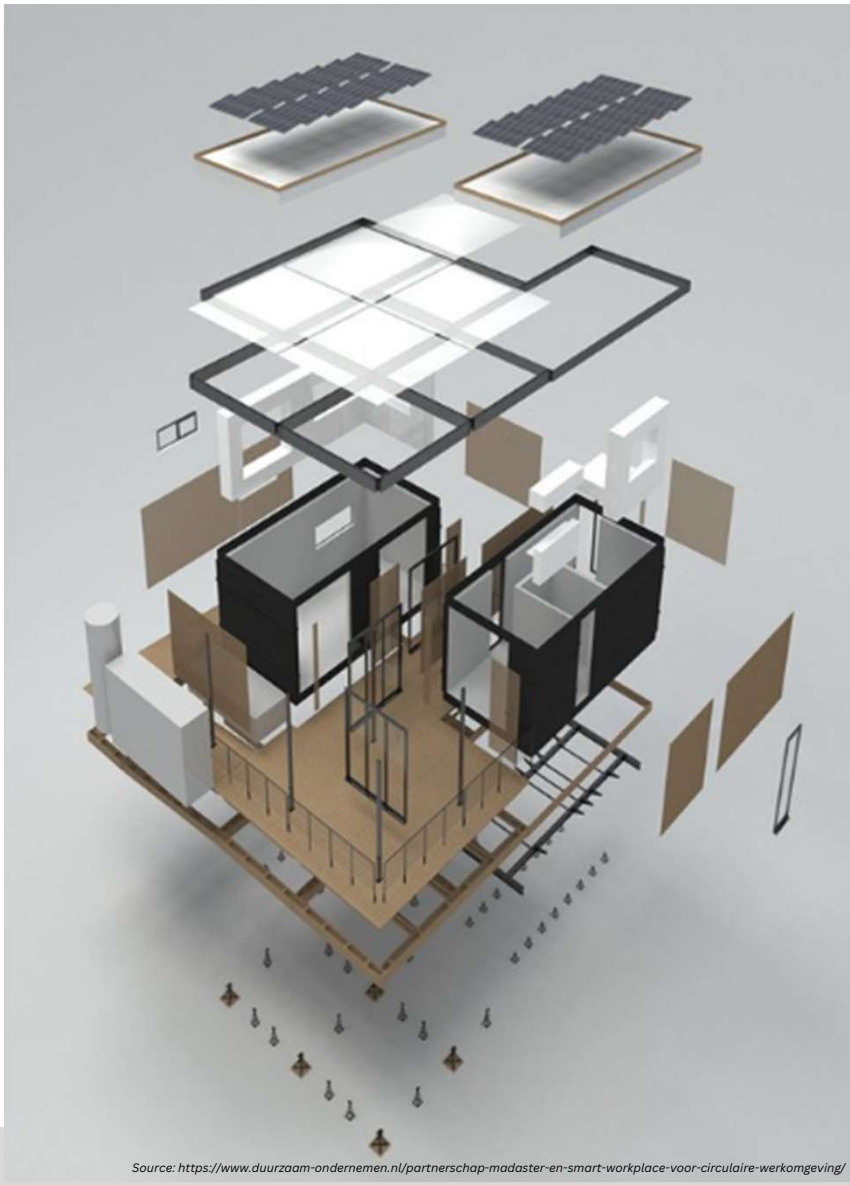


Source: https://www.duurzaam-ondernemen.nl/partnerschap-madaster-en-smart-workplace-voor-circulaire-werkomgeving/

Motivation

The building industry significantly impacts the environment through high resource and energy consumption, and waste production

Environmental Impact of the Building Industry

- Responsible for 21% of global greenhouse gas emissions
- Accounts for 34% of global energy demand
- Contributes 37% of energy and process-related CO2 emissions

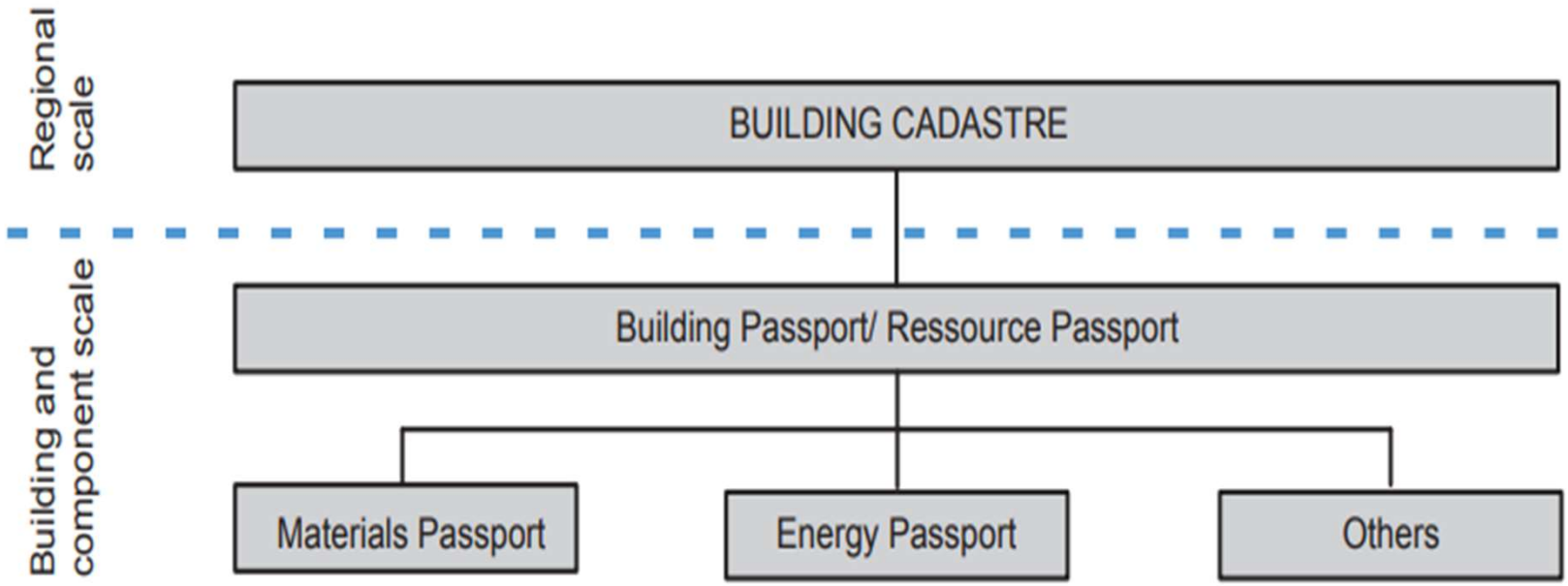
Transitioning to a Circular Economy, as proposed by the European Union (EU) (McMillan, 2019), offers a solution to this problem

→ To reuse materials their location, type and quantity must be registered

Source: https://www.unep.org/resources/report/global-status-report-buildings-and-construction
Source: https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf
Source: McMillan, Sarah E (2019). "Closing the Loop": THE EUROPEAN UNION & THE CIRCULAR ECONOMY". In: Scitech Lawyer 15.4, pp. 4–8.

Materials Passport

- EU's Horizon 2020 project Building as Material Banks (BAMB) - aims to enable the shift to a circular building sector
- Material Passports, Energy Passports, Reversible Building Design, Business Models, Policy and Standards



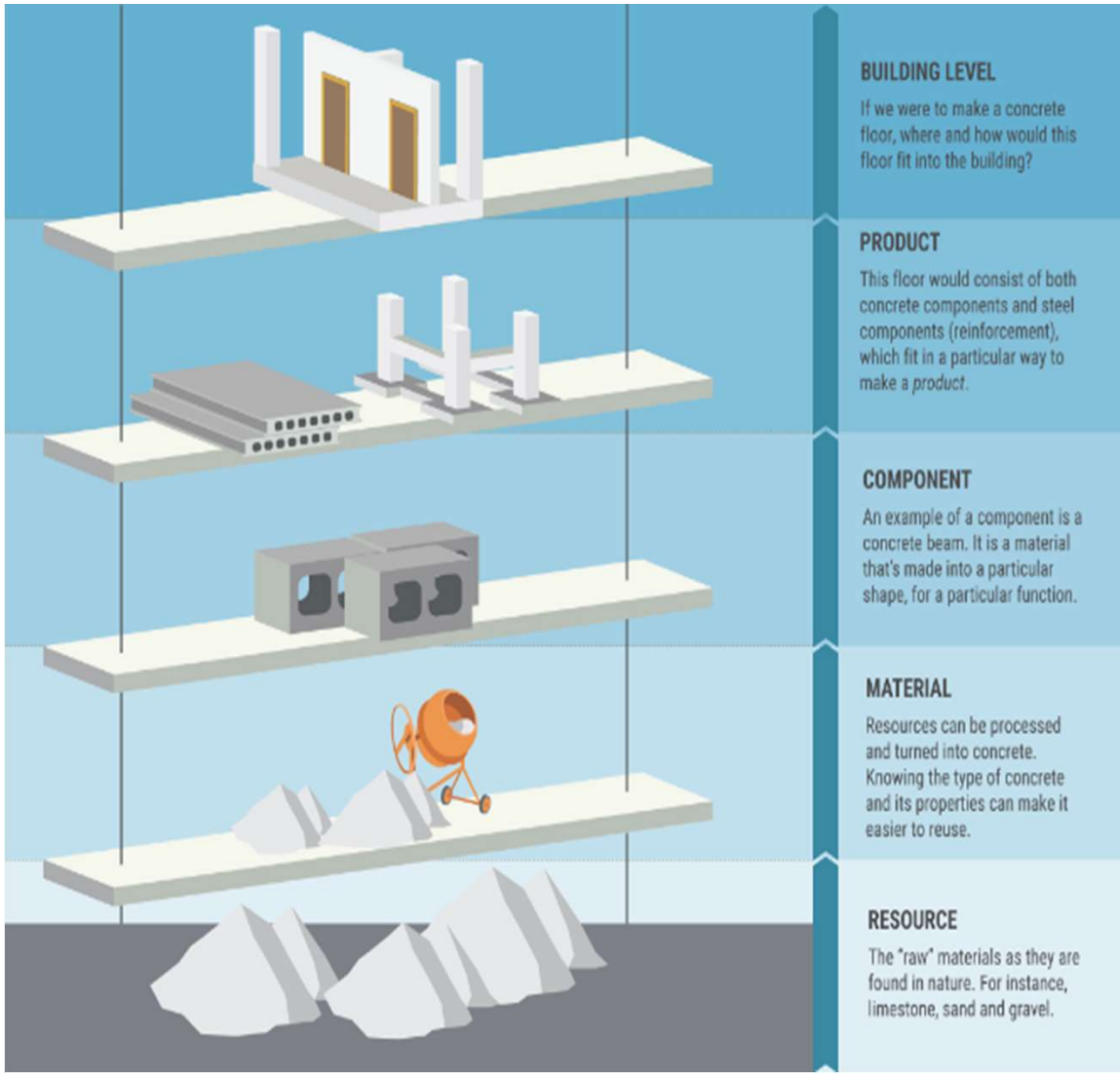
Source: https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf

Materials Passport

- The Material Passports (MP) is an electronic set of data, which evaluates the recycling potential and environmental impact of materials embedded in buildings.

- Data entered into a centralised database
- Customised reports tailored to diverse user needs
- Material passports comprise multiple hierarchical levels

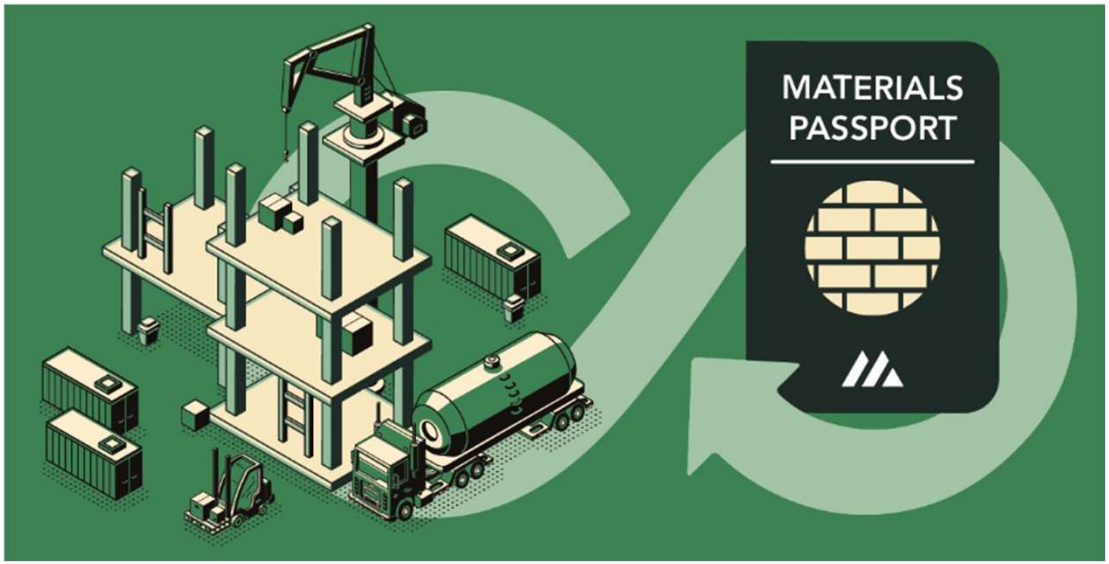
→ **Currently no standarisation of Material Passports**



Source: https://www.bamb2020.eu/wp-content/uploads/2019/02/BAMB_MaterialsPassports_BestPractice.pdf

What are applications of Building Material registration?

1. Supporting Circularity
2. Valuation of Building
3. Environmental Impact
4. Safety and Security

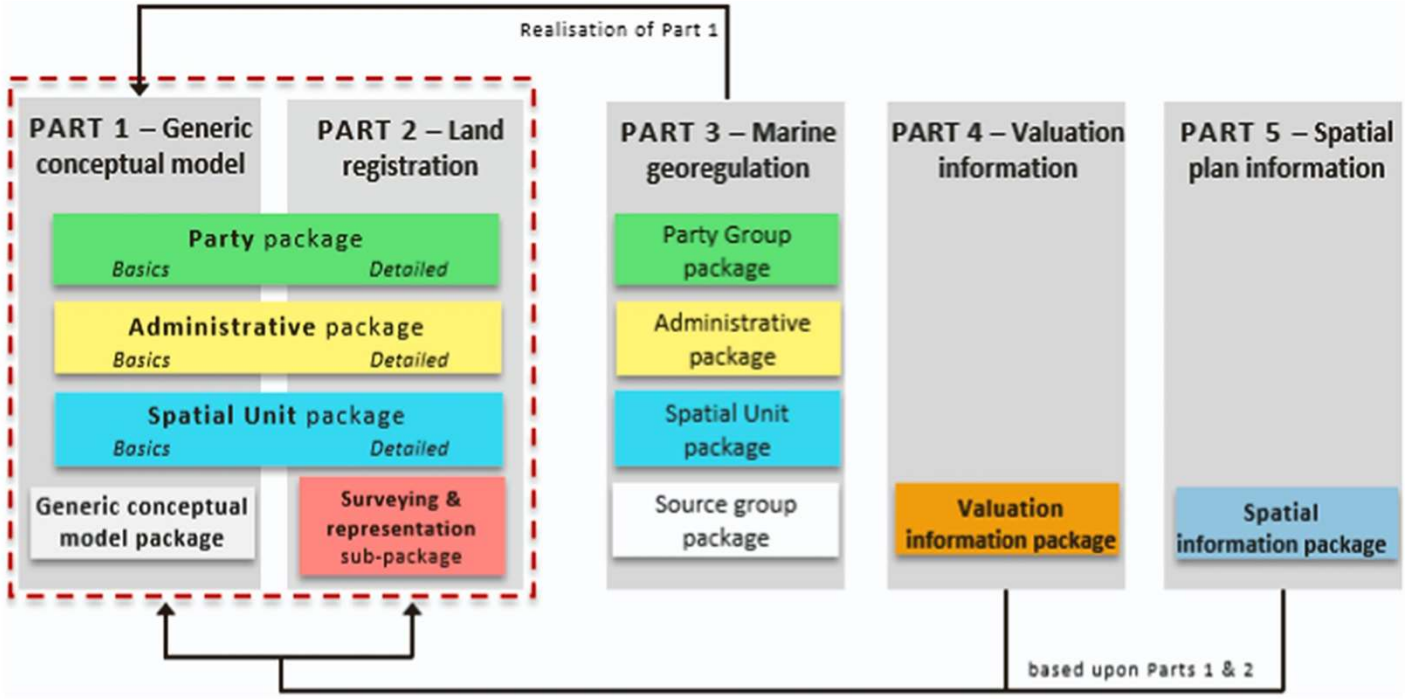


Why relate building material registration to LADM?

1. Ownership information from the land administration is needed for the registration of building materials
2. Restrictions, e.g. due to heritage or monument statis, is also required (both in Part 2)
3. The valuation is relevant (knowing the materials, better valuation can be done), LADM Part 4
4. LADM provides data on location and distance details
5. The systematic registration approach used in land administration are well-suited to the concept of a material passport
   - Registration of Building Material (Information gathering)
   - Information Provision of Building Material (search function)
6. Land Administration style legislation, governance, and organization would be suitable

Land Administration Domain Model (LADM)

LADM is a conceptual model designed to facilitate the standardisation of land administration.

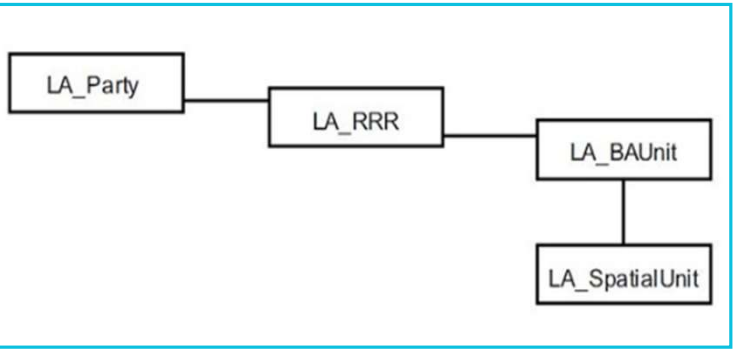


The LADM ISO19152 II contains 6 parts-

1. Conceptual Model
2. Land Registration
3. Marine Georegulation
4. Valuation Information
5. Spatial Plan Information
6. Implementation aspects
7. Building Materials ?

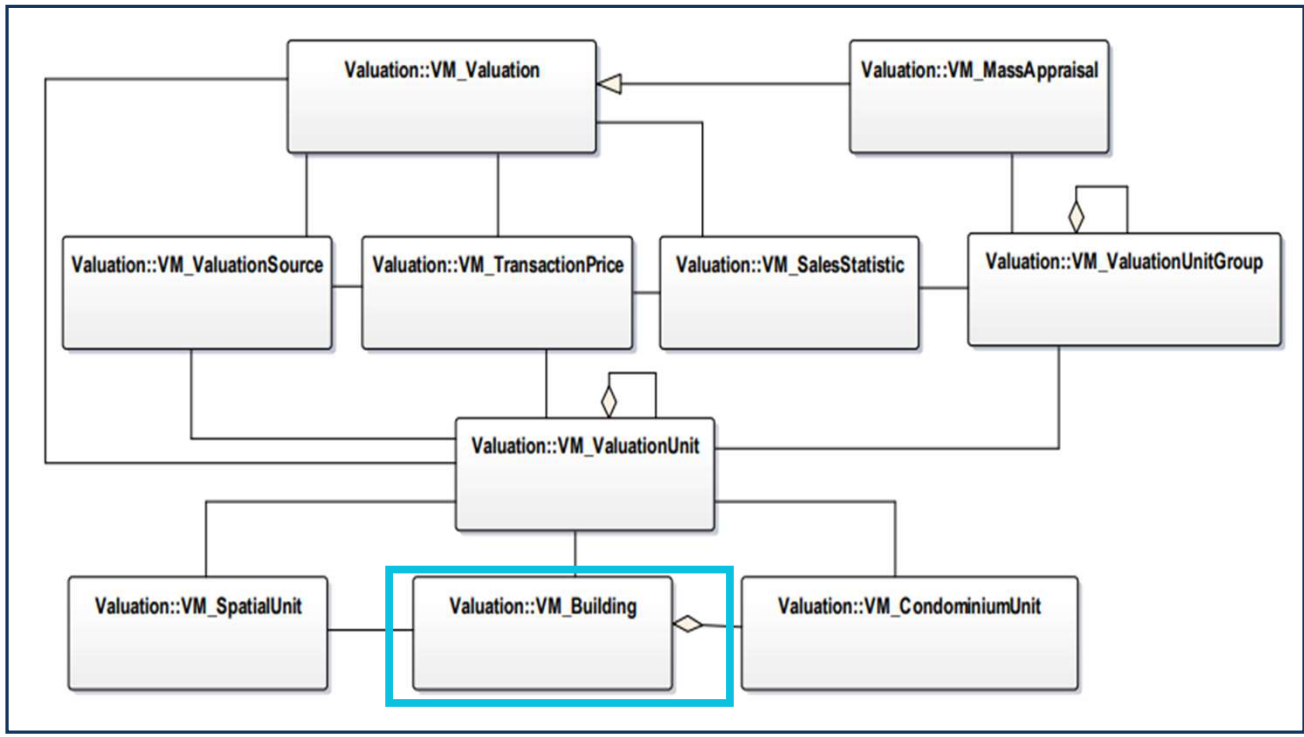
Source:Kara, Abdullah, Christiaan Lemmen, Peter van Oosterom, Eftychia Kalogianni, Abdullah Alattas, and Agung Indrajit. "Design of the new structure and capabilities of LADM edition II including 3D aspects." Land use policy 137 (2024)

Relevant LADM Information



The four fundamental categories of the core LADM
→ owners, restriction, location,…

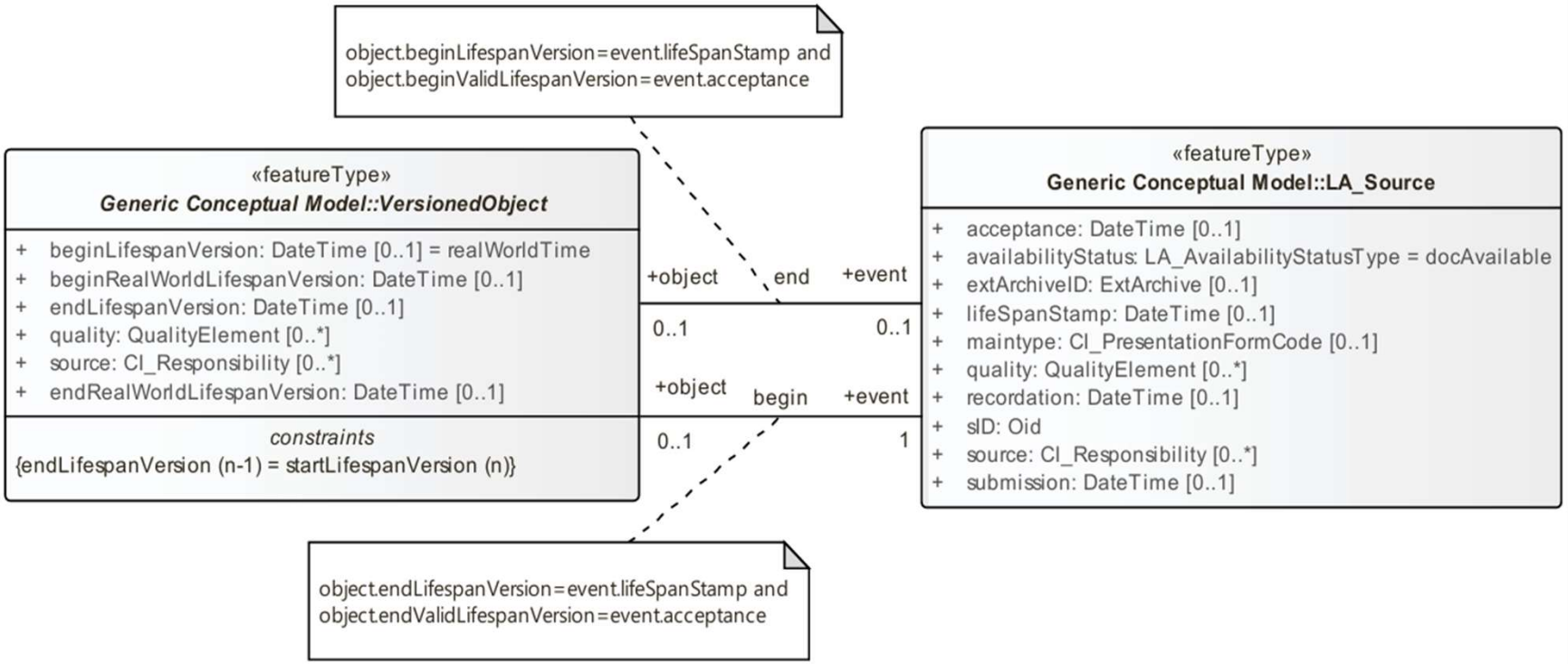
Basic classes of the LADM Valuation Information Package
→ building, value,…



Source:ISO 19152-1:2024: Geographic information -- Land Administration Domain Model (LADM). ISO. 2024
SSource:ISO 19152-1:2024Geographic information — Land Administration Domain Model (LADM)Part 1: Generic conceptual model

Registration basis: source documents and versioning

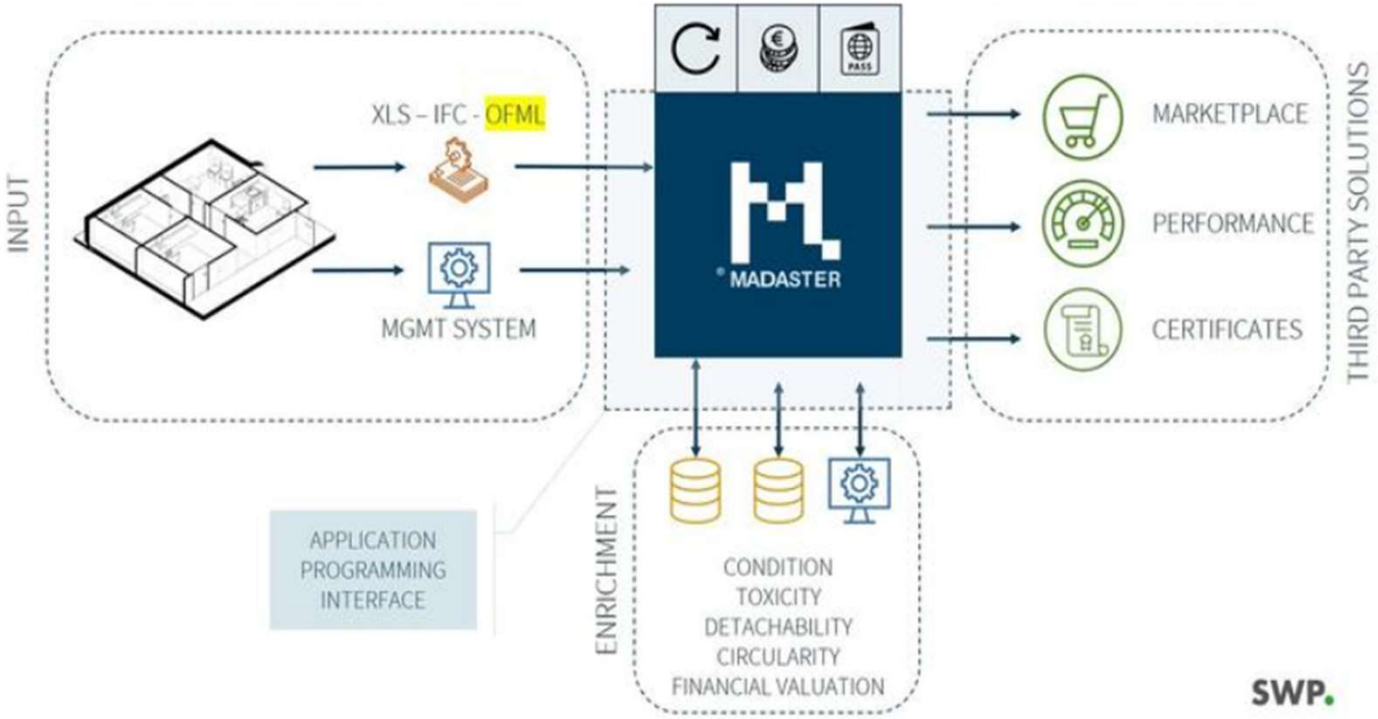
- **LA_Source class** - supports different types of sources and represents events that trigger changes in the registration process
- **VersionedObject class -** abstract class - management and maintenance of historical data



Source:ISO 19152-1:2024Geographic information — Land Administration Domain Model (LADM)Part 1: Generic conceptual model

Madaster

- Madaster is a platform with an online library of materials in the built environment, it links the material identity to the location and records this in a **Materials Passport**
- Currently, Madaster operates in the Netherlands, Germany, Norway, Switzerland, Belgium and is expanding to more countries



Source: https://www.duurzaam-ondernemen.nl/partnerschap-madaster-en-smart-workplace-voor-circulaire-werkomgeving/

Madaster

- Madaster input data: **IFC file** or **Madaster Excel** template, as shown here
- Performance dashboard (private/residential user)

Source: https://www.duurzaam-ondernemen.nl/partnerschap-madaster-en-smart-workplace-voor-circulaire-werkomgeving/

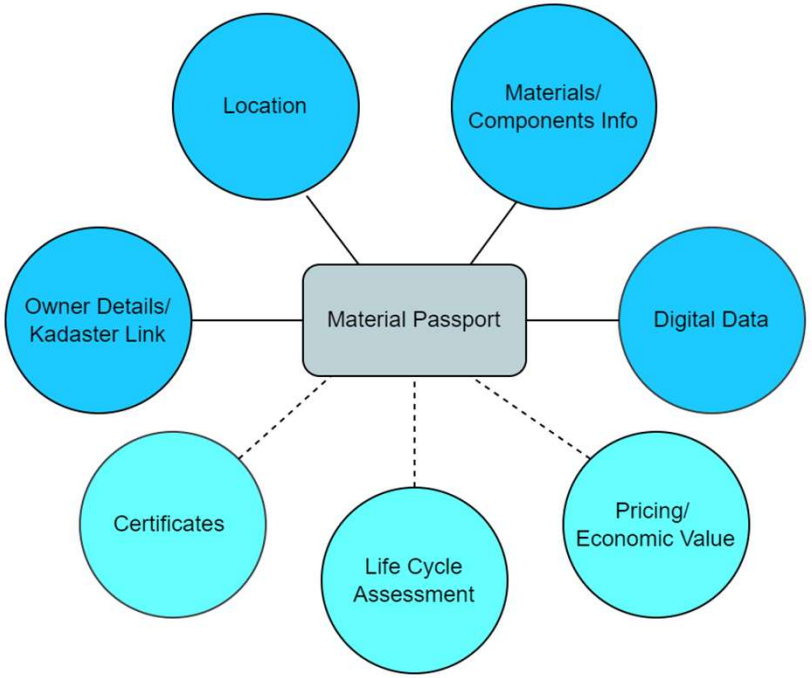
Standardisation - Material Passport

Requirement	IFC	Excel
Location	✓	✗
Materials/ Components Info	✓	✓
Owner Details/ Kadaster Link	✓	✓
Pricing/ Economic Value	✗	✓
Life Cycle Assessment	✗	✗
Certificates	✗	✗

Comparing IFC and Excel data formats based on the requirements

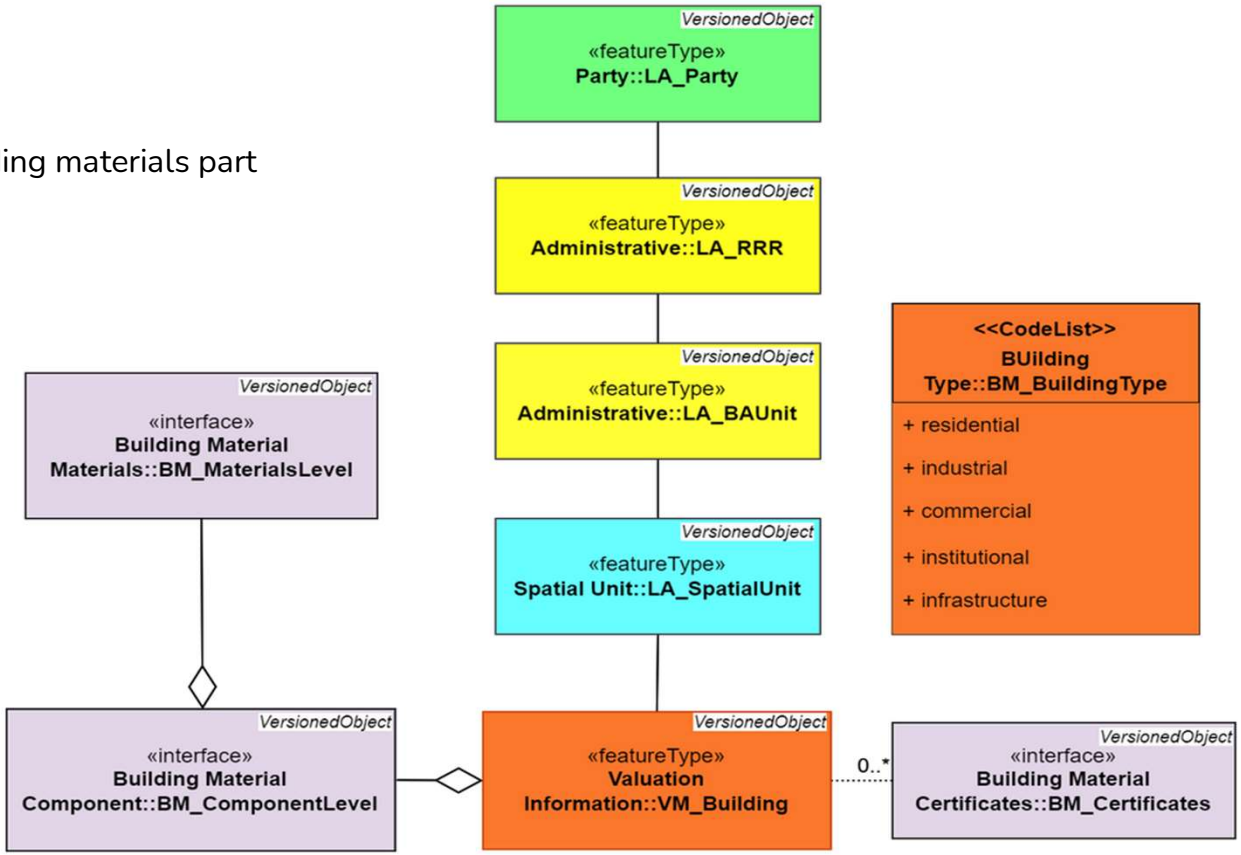
Standardisation - Material Passport

- **Dark blue** - mandatory requirements
- **Light blue** - optional requirements



Initial Information Model Proposal Building Materials

UML diagram showing the classes of Building materials part and its relation to the core LADM classes



Possible Attributes for Building Materials

The organization on Madaster Excel template as inspiration (mix of material and component level)

A	Optional, for use in matching: GTIN (EAN) of the product
B	Optional, for use in matching : Manufacturer's article number, Eventually concatenated with the manufacturer's GLN
C	Optional, for use in matching: The identifier of the product in a database of the Madaster Platform.
D	Optional, for use in matching: The identifier of the product in an external database supported by Madaster.
E	Optional: add a description/typename for the element
F	Enter your material- or product name.
G	Enter the code from the classification.
I	Enter the floor on which the supplied material/product is located.
J	Optional, enter the number of elements (when empty, it is considered 1).
K	Enter the area in m^2, or
L	Enter the length in m
M	Enter the volume in m3, or
N	Enter the weight in kilograms.
O	Optional, enter the thickness of the element in m.
P	Optional, enter the height of each element in m.
Q	Optional: Enter the width of each element in m.
R	Optional, Enter the diameter of product if relevant.

Code List Values for Building Materials

Building Materials status

1. Demolition
2. Preserved
3. Construction Waste
4. New materials

Classification code	Classification name
1	Surroundings
2	Structure
3	Skin
4	Services
5	Space plan
6	Stuff

Nature of waste	
Id	Name
NonHazardous	Non-hazardous
Hazardous	Hazardous
Inert	Inert

End of life scenario	
Id	Name
10	Reuse of OO element/material
15	Reuse of CW (preparation for)
20	Onsite recycling
25	Offsite recycling
30	In-situ remediation/recycling of contar
35	Ex-situ remediation/recycling of contar
40	Onsite recovery as backfill/ landscapin
45	Offsite recovery as backfill/ landscapin
50	Waste to energy plant
55	Incineration plant
60	Inert waste landfill
65	Non-hazardous waste landfill
70	Stable non-reactive hazardous waste la
75	Hazardous waste landfill

Waste codes	
Classification code	Classification name
16 02	Wastes from electrical and electronic equipment
16 02 09*	transformers and capacitors containing PCBs
16 02 10*	discarded equipment with PCBs other than those in 16 02 09
16 02 11*	discarded equipment containing chlorofluorocarbons, HCFC, HFC
16 02 12*	discarded equipment containing free asbestos
16 02 13*	discarded equip. with haz. components other than 16 02 09 to 16 02 12
16 02 14	discarded equipment other than those mentioned in 16 02 09 to 16 02 1
16 02 15*	hazardous components removed from discarded equipment
16 02 16	components removed from discarded equip. other than those in 16 02 1
17 01	Concrete, bricks, tiles and ceramics
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 06*	mix. or separate fractions of concrete, brick, tile&ceramic cont. dang. sub
17 01 07	mix of conc., brick, tile&ceramic other than those mentioned in 17 01 06
17 02	Wood, glass and plastic
17 02 01	wood
17 02 02	glass
17 02 03	plastic
17 02 04*	glass, plastic & wood containing or contaminated with dang. substances
17 03	Bituminous mixtures, coal tar and tarred products
17 03 01*	bituminous mixtures containing coal tar
17 03 02	bituminous mixtures other than those mentioned in 17 03 01
17 03 03*	coal tar and tarred products

Practical Aspects

Tools and datasets

- **Software** - The software used will be PostgresSQL, Open IFC viewer, Revit , draw.io
- **Dataset** - The new datasets will be IFC, while the old dataset will be laser scans, floor plans, documents

Collaborations

- **Madaster**
- **Circular Built Environment Hub, TU Delft (circularity experts)**
- **TU Delft Campus Real Estate & Facility Management (CREFM)**

Next steps

1. Refine initial Information model LADM part 7, Building Materials → attributes, code lists,,..
2. Evaluate with building circulatory experts, and if needed refine model
3. Select one old and one new building from TU Delft Campus
    - For new building use IFC documentation, and convert into LADM part 7 database (PostgreSQL)
    - For old building collect, measure relevant information and again store in database
4. Analyse the fitting of real data in model, and if needed refine model
5. Perform a search query for specific type/quantity of materials close to a give location

Conclusion

1. Very first idea for Building Material registration within context of LADM was presented
2. Still work in progress, and initial proposal for LADM part 7

→ What do you think? Needed/Not Needed/No Opinion (raise hands)

Questions?