Spatial Plan Registration and Compliance Checks in Estonia, based on LADM Part 5 - Spatial Plan Information

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FUTURE INSIGHT

TU Delft

MSc Geomatics, TUDelft – P5
October 29, 2024

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1. Introduction
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3. Country Profile of Estonia
4. Implementation
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Thesis Report

1. Introduction

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Collaboration with Future Insight

Case study based on the company's PlanBIM project in collaboration with the Ministry of Climate (*Kliimaministeerium*) of Estonia.

1. Introduction

Research Problem

Simplified Permitting Process

1 → **2** → **3** → **4**

Planning Process

Saving the Model

Checking of Adherence to Regulations and Policies

(e.g., Detailed Plan against Master Plan's regulations)

Permit Checks/Permitting

1. Introduction

Research Problem

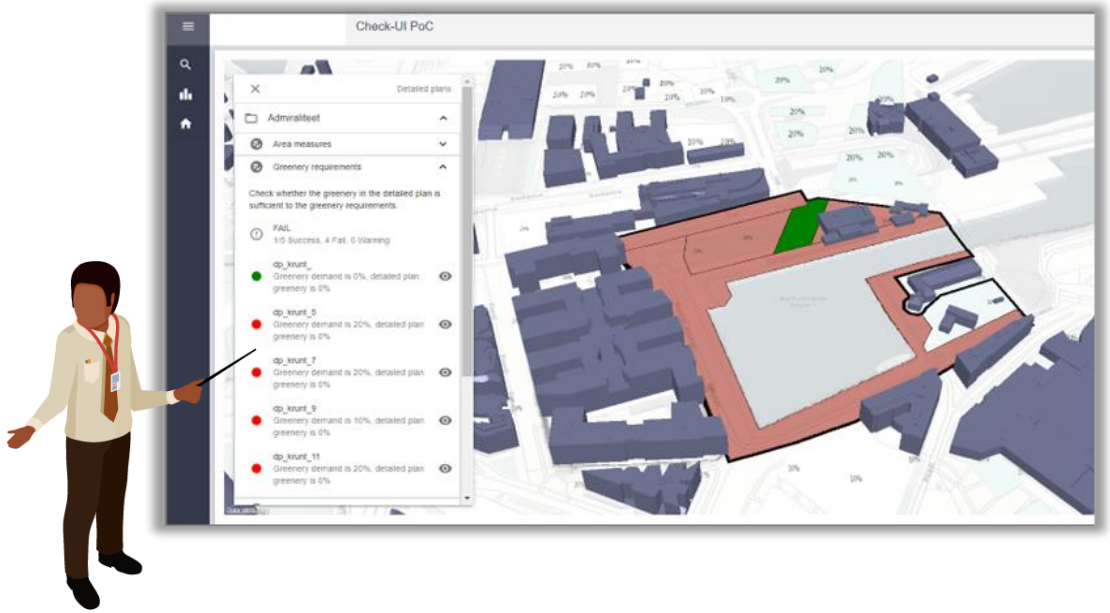
Manual plan permitting

- Prolonged processing times
- Increased potential for errors
- Limited collaboration among stakeholders

1. Introduction

Research Problem

Manual plan permitting



Using BIM/IFC models for permitting

Recognizing the shortcomings
of this manual system

1. Introduction

Research Problem

From Planning Stage to Permitting

This research focuses on early compliance checks to simplify and streamline the later permitting step.

1 Planning Process

2 Saving the Model

3 Checking of Adherence to Regulations and Policies

(e.g., Detailed Plan against Master Plan's regulations)

4 **Permit Checks/Permitting**

1. Introduction

Research Problem

From Planning Stage to Permitting

Using BIM/IFC models for early compliance checks streamlines planning and simplifies permitting by ensuring regulations are met before formal applications.

1 Planning Process

2 Saving the Model

3 Checking of Adherence to Regulations and Policies

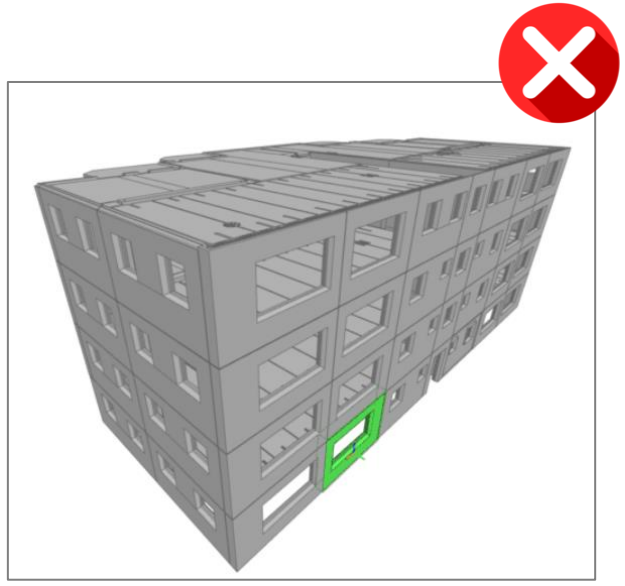
(e.g., Detailed Plan against Master Plan's regulations)

4 Permit Checks/Permitting

1. Introduction

Research Problem

Unlike the traditional use of IFC models as design models, in this research, IFC is utilized as a **Plan Information Model**, focusing on spatial planning rather than detailed building designs.



IFC as a
Design Model

IFC as a
Plan Information Model

1. Introduction

Research Problem

Proposed pipeline

From Planning Stage to Permitting

1 → 2 → 3 → 4

Planning Process

Saving the Model

Compliance Checks and Validation

(e.g., Detailed Plan against Master Plan's regulations)

Digital Permitting

1. Introduction

Research Problem

"How can **BIM/IFC** *be leveraged for the*
registration of spatial plans *and* **compliance checking** *in Estonia,*
utilizing **LADM Part 5** *Spatial Plan Information (ISO19152-5)?"*

1. Introduction

Research Problem

Proposed pipeline

From Planning Stage to Permitting

1 → 2 → 3 → 4

Planning Process

Saving the Model

Compliance Checks and Validation

(e.g., Detailed Plan against Master Plan's regulations)

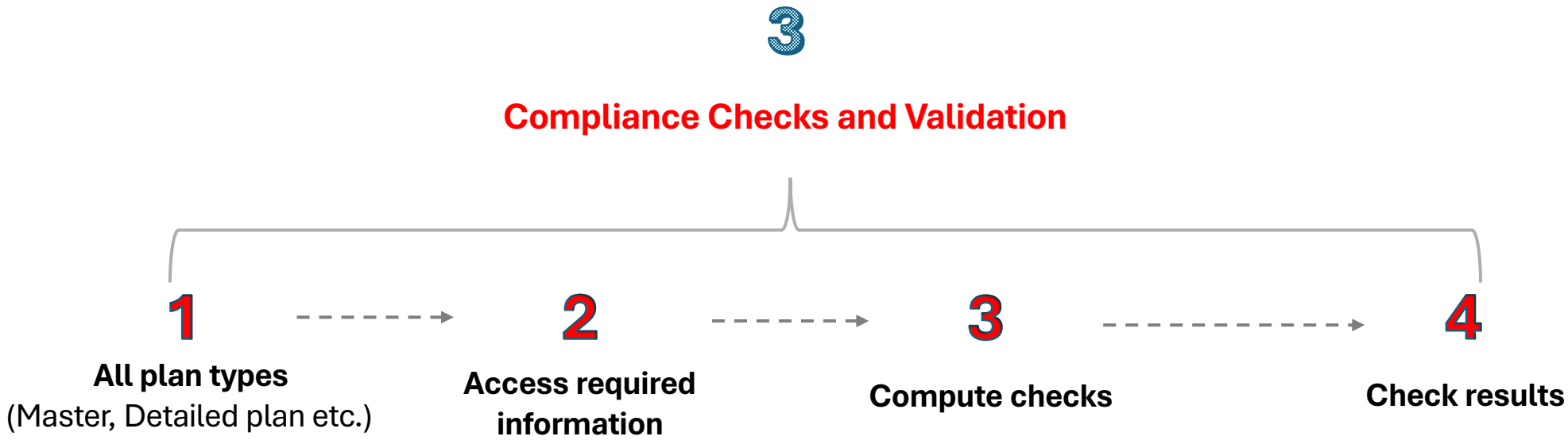
Digital Permitting

1. Introduction

Scope

Proposed pipeline

From Planning Stage to Permitting



1. Introduction

Scope

1

All plan types
(Master, Detailed plan etc.)

IFC CityGML

2

Access required information

3

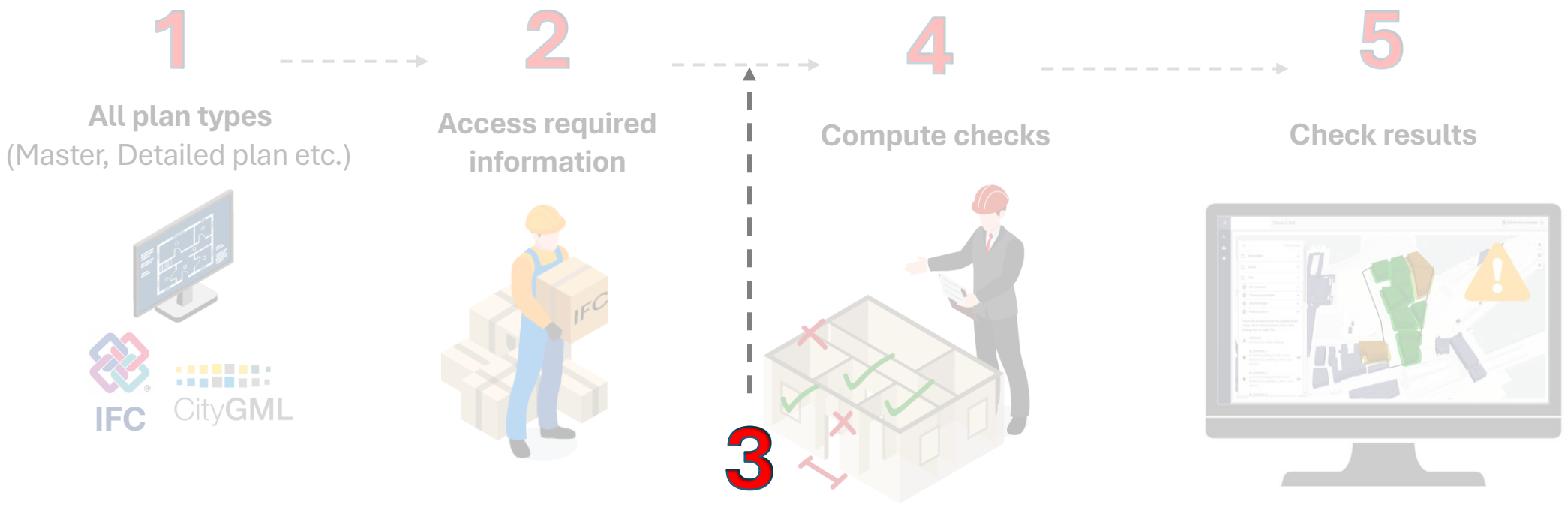
Compute checks

4

Check results

1. Introduction

Scope

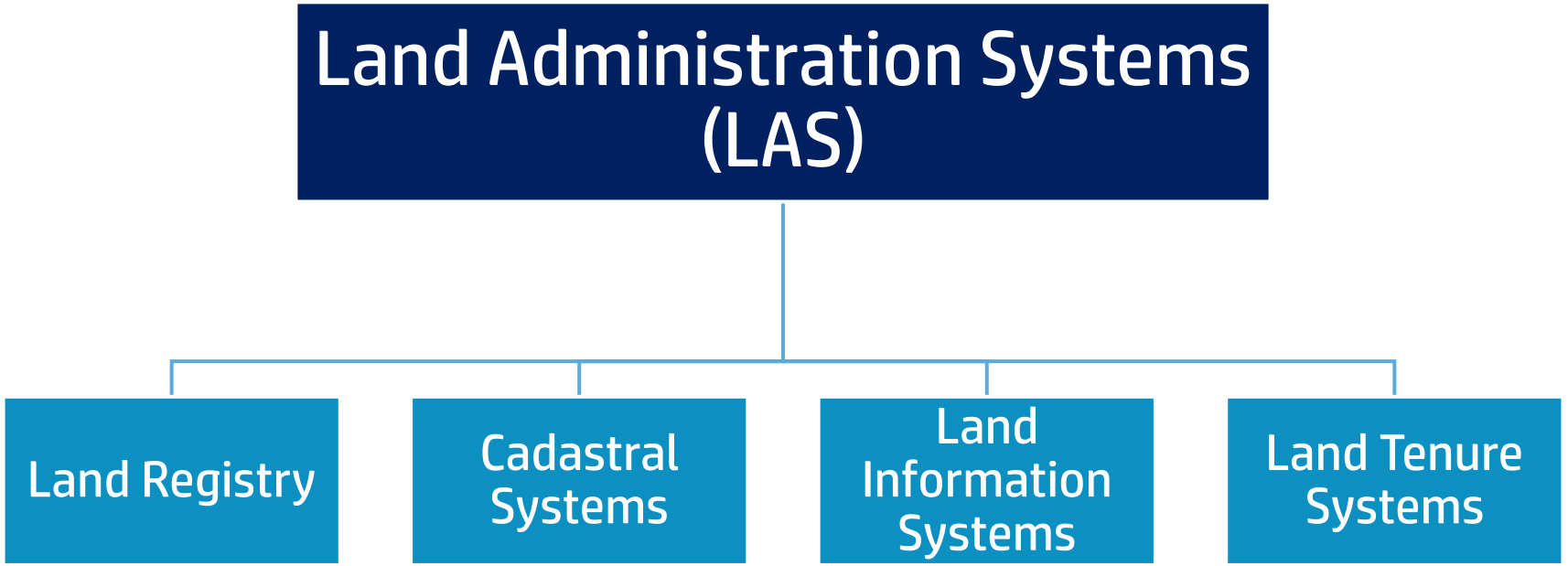


Store information through LADM

LADM can help to structure the plan data that is necessary to be able to execute the checks in a standardized and structured way.

1. Introduction

LADM



1. Introduction

LADM

Land Administration Domain Model (LADM)

- ISO standard (ISO19152:2012)
- Serves as an infrastructure for efficient land administration systems
- Provides a mutual ontology
  - for promoting shared information

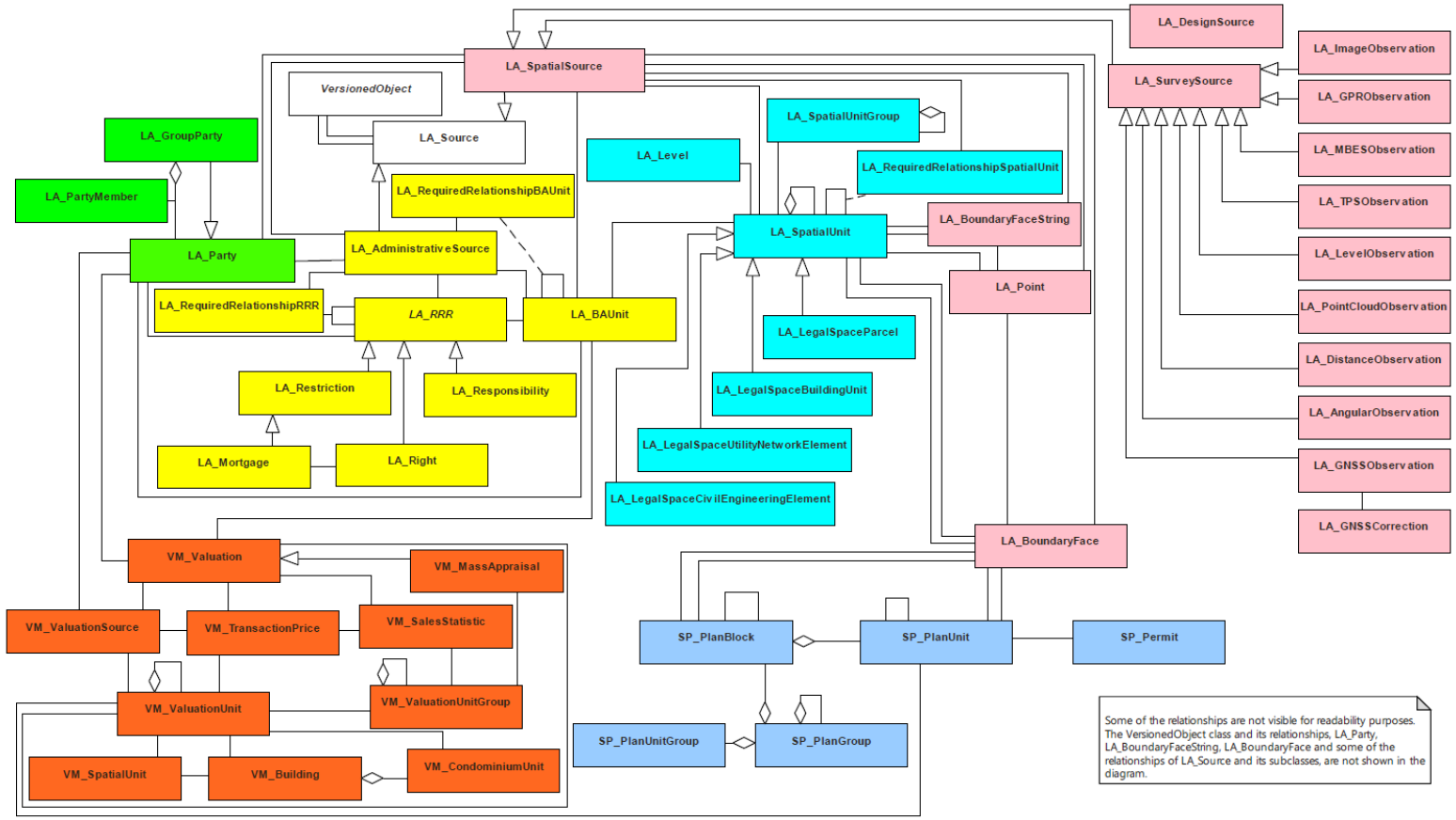


Fig. LADM Edition II parts 1, 2, 4 and 5 and their relationship (Kara et al. 2024)

1. Introduction

LADM

In 2018, **LADM Edition II** started to be developed

- the **need to enhance certain aspects of land administration** that were not covered in the first edition
    - *E.g.,* land value, land use, and maritime spaces

1. Introduction

LADM

LADM Edition II

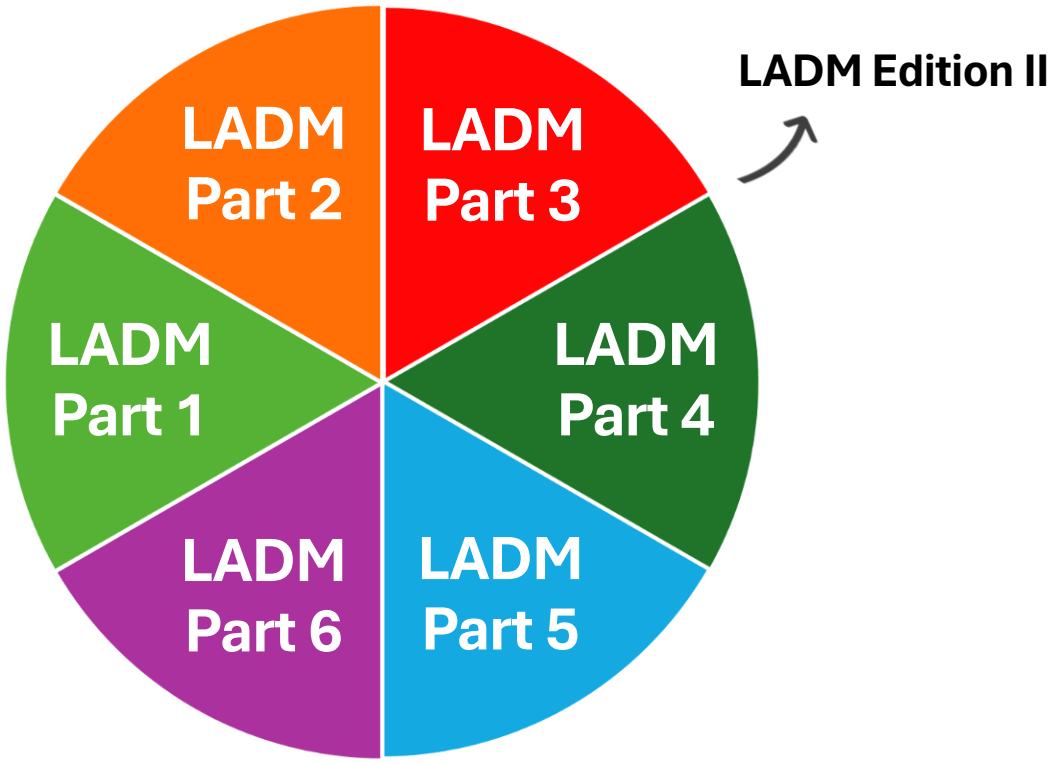
- introduces a **multi-part structure with six parts**
- offer more focused coverage compared to the original, single-document approach of LADM Edition I (ISO 19152:2012).

1. Introduction

LADM

LADM Edition II

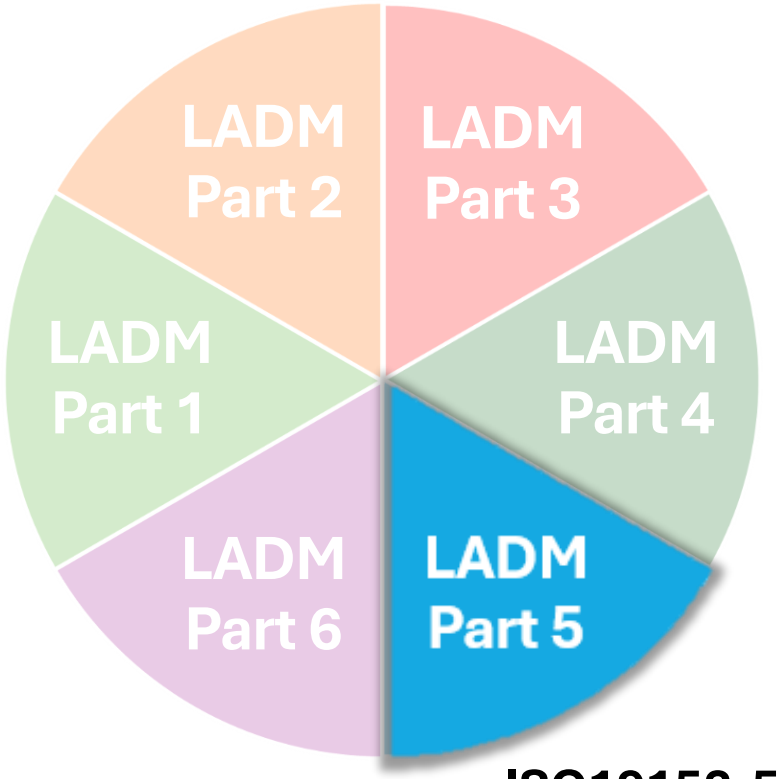
- **Part 1:** Generic Model
- **Part 2:** Land Registration
- **Part 3:** Marine Georegulation
- **Part 4:** Valuation Info
- **Part 5:** Spatial Plan Info
- **Part 6:** Implementation



1. Introduction

LADM Part 5

To store and utilize map data **LADM Part 5** is the most relevant standard to be used in the research.



ISO19152-5: Spatial Plan Info

1. Introduction

LADM Part 5

ISO19152-5: Spatial Plan Information

- Integrates land registry with planned land use
- Supports planning hierarchies and plan units
- Provides codelists for spatial functions
- Enables permit registration

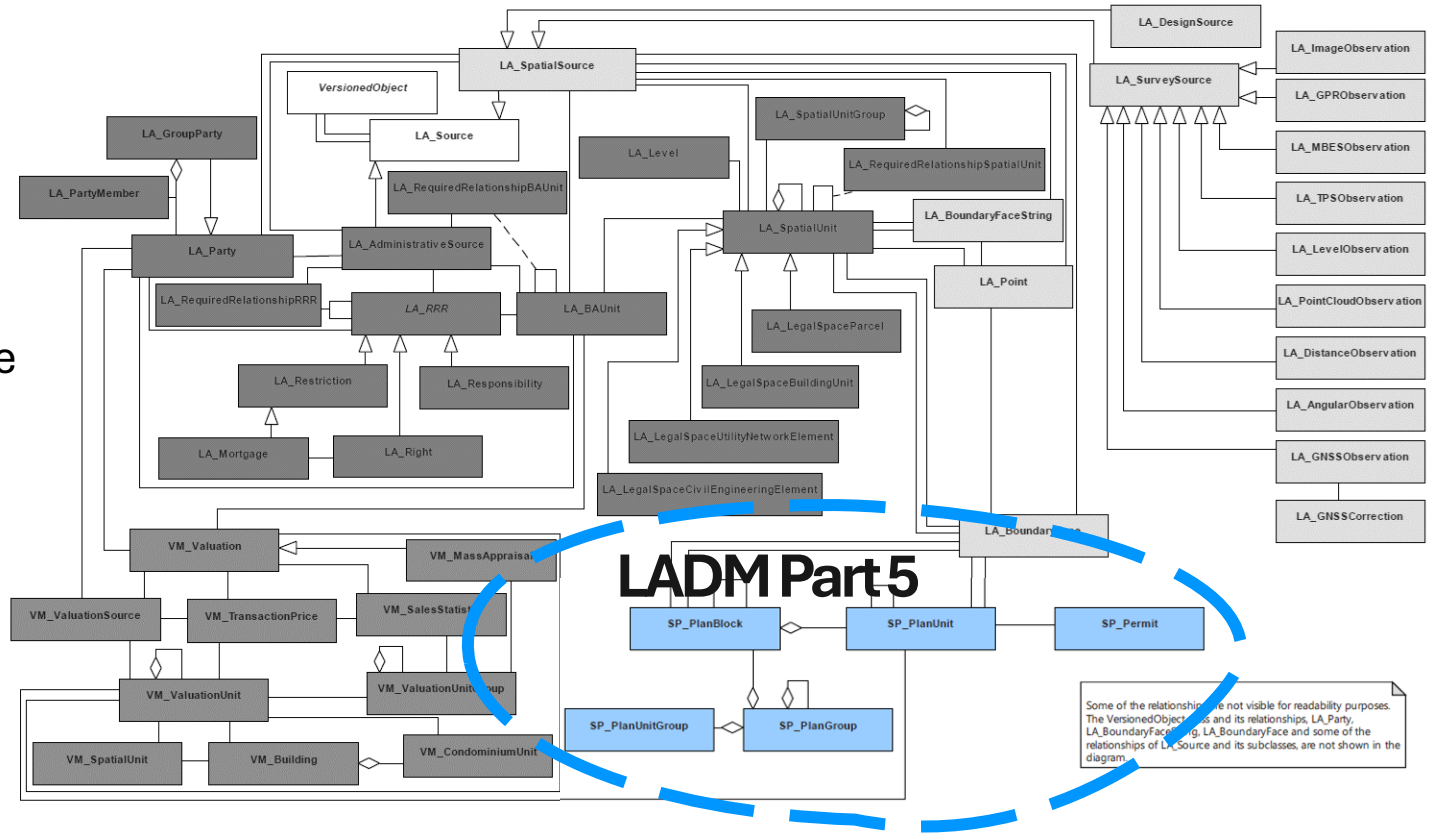
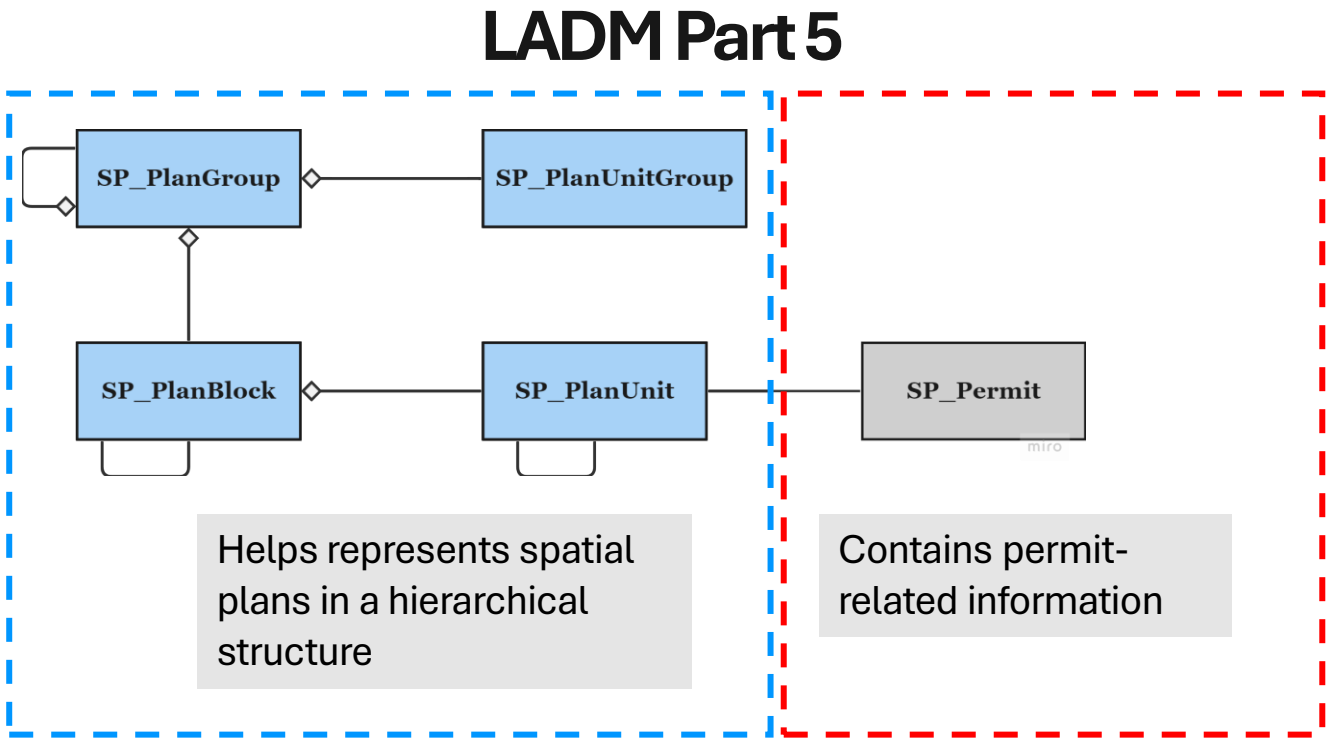


Fig. LADM Edition II parts 1, 2, 4 and 5 and their relationship (Kara et al. 2024)

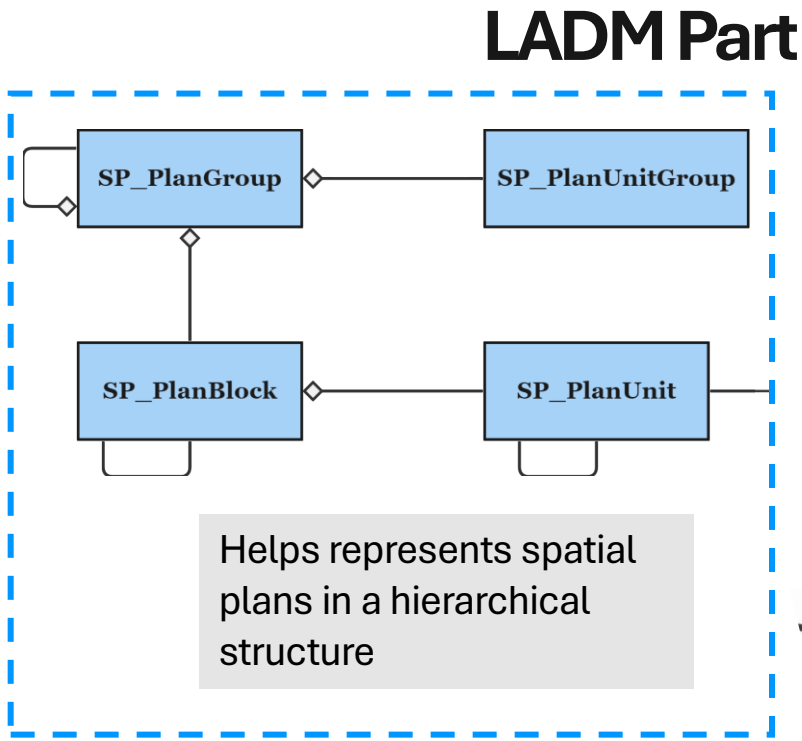
1. Introduction

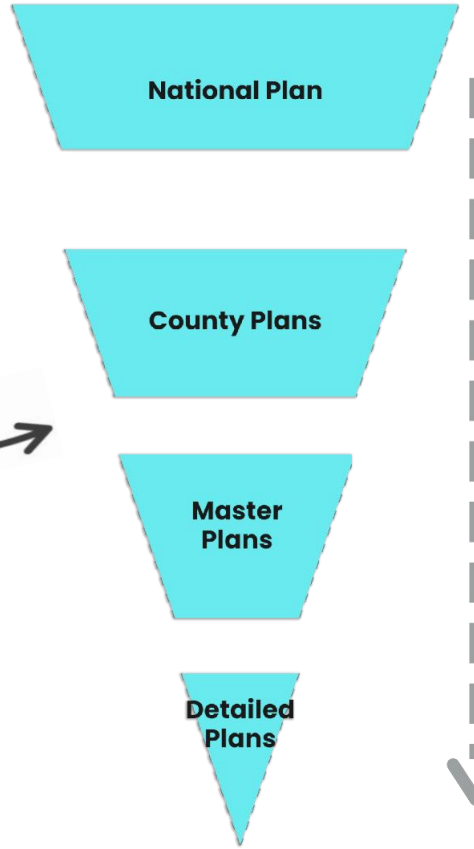
LADM Part 5

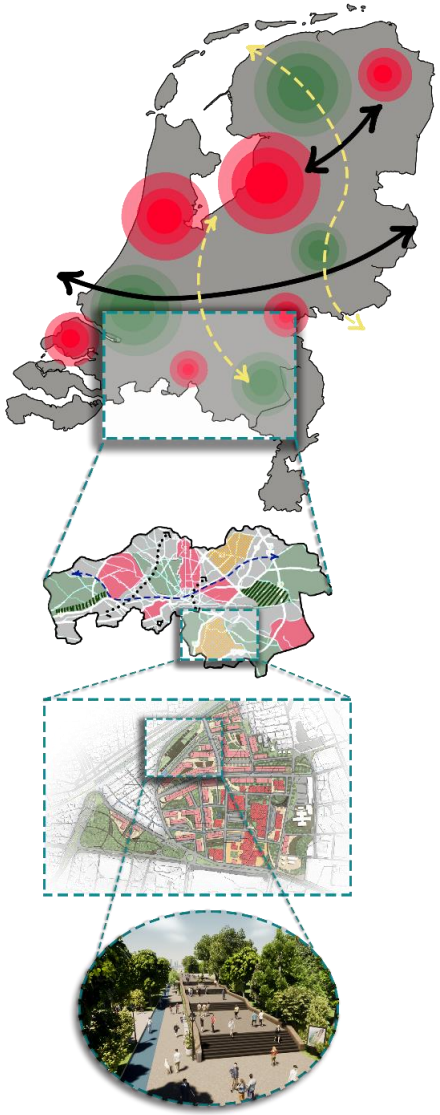


1. Introduction

LADM Part 5







1. Introduction

Methodology

1. Create a country profile in LADM Part 5
2. Create and use the LADM database to store data
3. Develop an import script to import plans to the database
4. Integration with the compliance checks

1. Introduction

Methodology

1. Create a country profile in LADM Part 5
2. Create and use the LADM database to store data
3. Develop an import script to import plans to the database
4. Integration with the compliance checks

A country (i.e., case study) is needed!

2. Case Study: Estonia

Relevant Projects with Estonia

2023 - 2024

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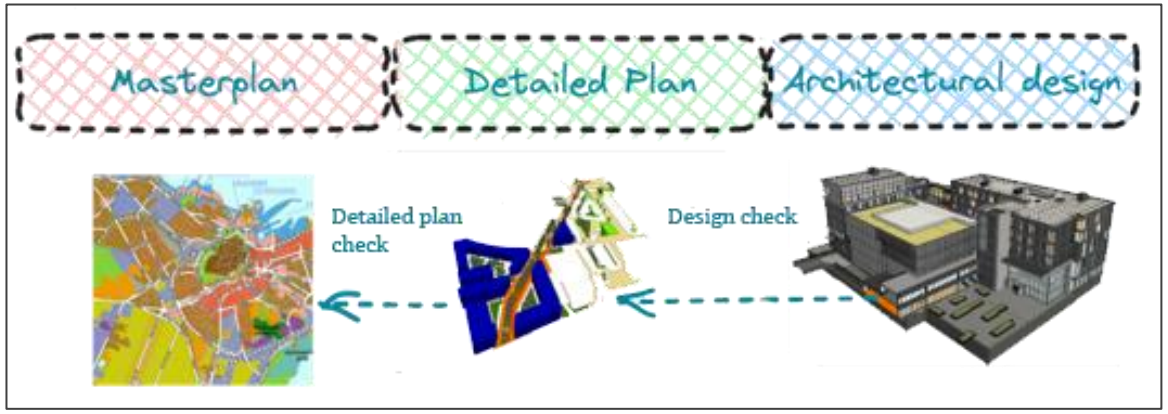
Automated Plan Compliance checks

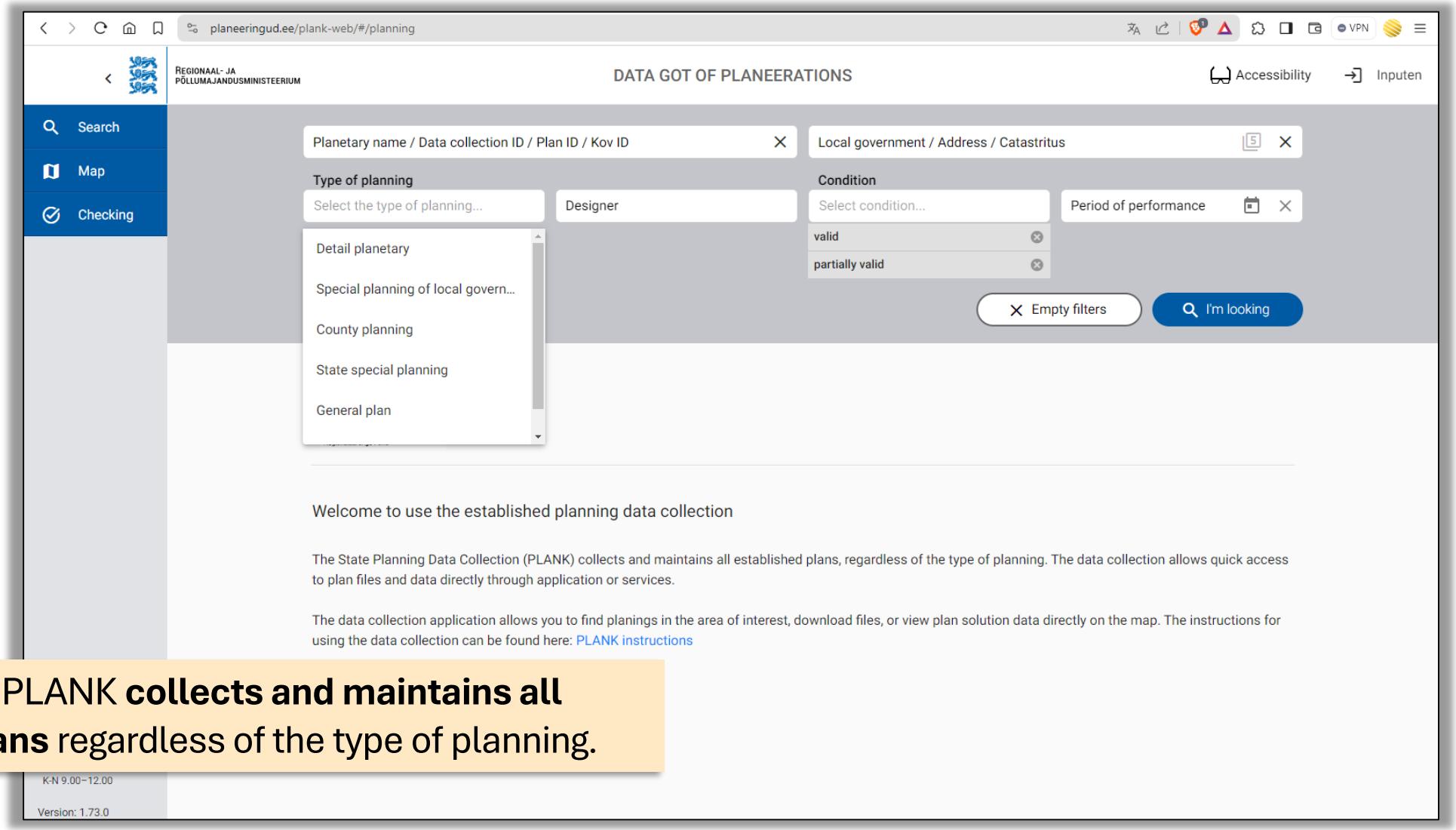
The project aims to apply **BIM-based compliance checks** in the earlier submission and review steps of Detailed Plans, requiring different techniques and data.



2. Case Study: Estonia

Estonia's PLANK

Planetary Data Collection *(PLANK)* platform



The nationwide PLANK **collects and maintains all established plans** regardless of the type of planning.

3. Estonia country profile

Country Profile

1. Create a country profile for Estonia in LADM Part 5
2. Create and use the LADM database to store data
3. Develop an import script to import plans to the database
4. Integration with the compliance checks

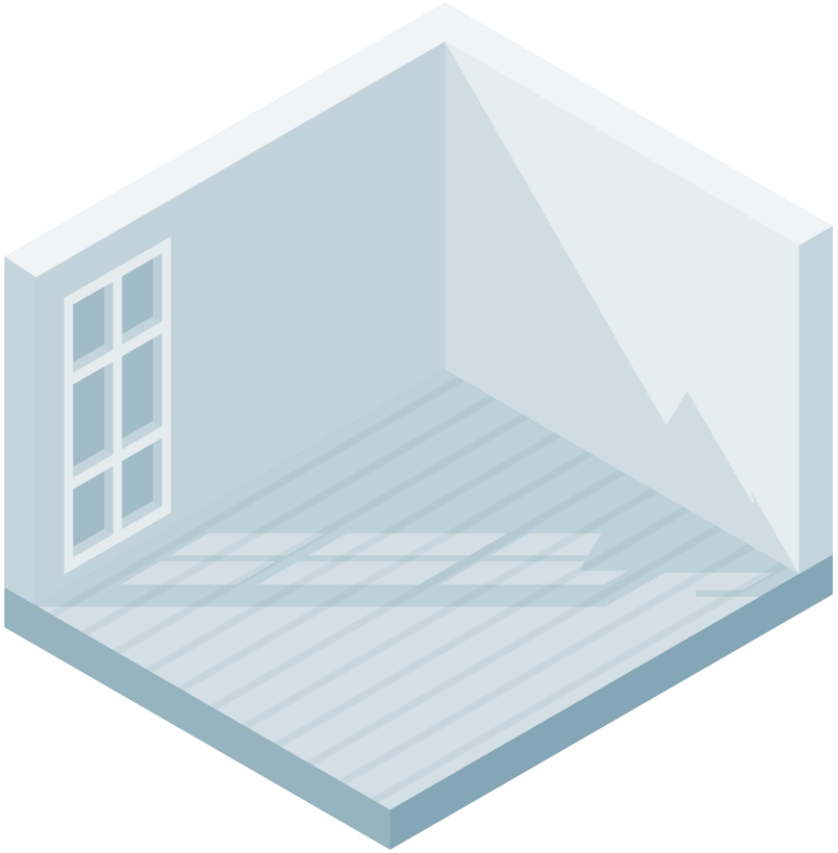
Why do we need to create a profile?

3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

An empty *“database”*



3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

Without a standardized framework...

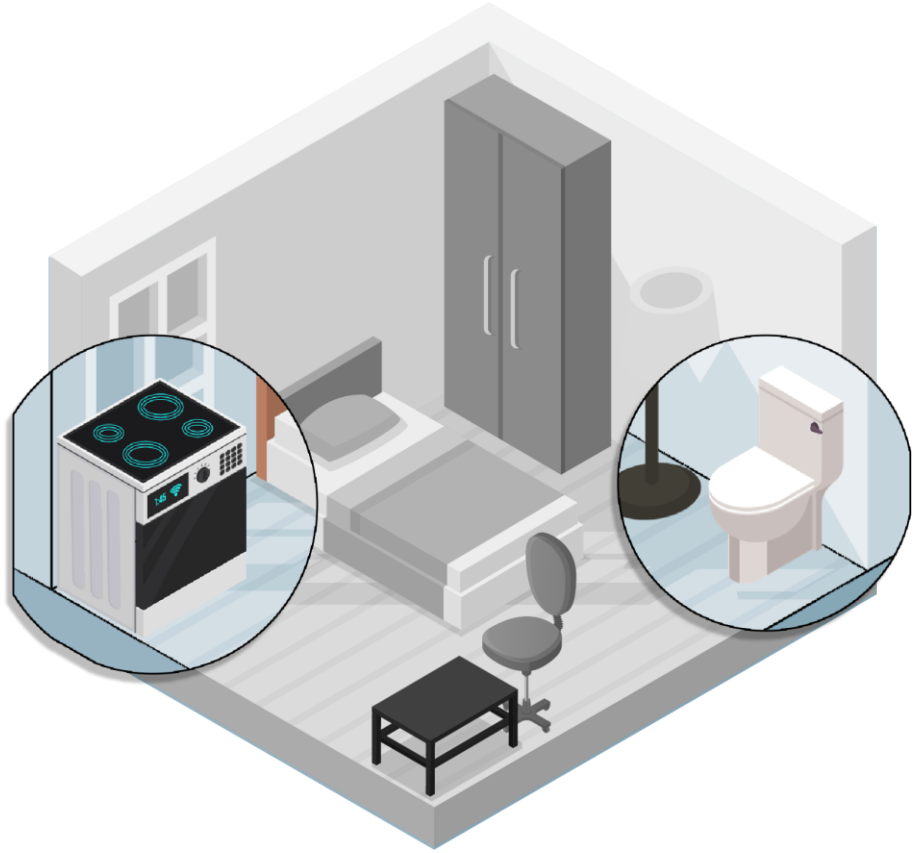
...data can be randomly stored.

3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

Of course, ***common sense*** can tell somethings don't belong together…



3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

But somethings can vary according a ~~*person*~~ *country*…

… **causing ambiguity** for people who are not familiar with how the data is structured in this ~~*room*~~ *country*.

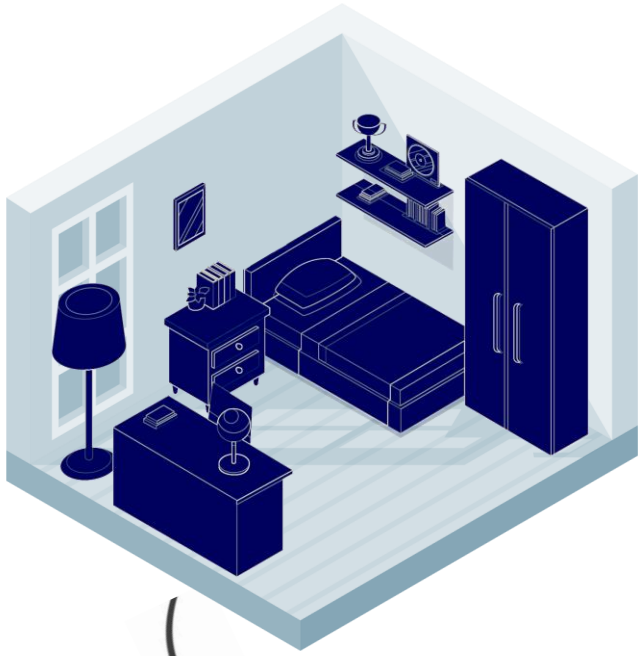
3. Estonia country profile

Why do we need a country profile?

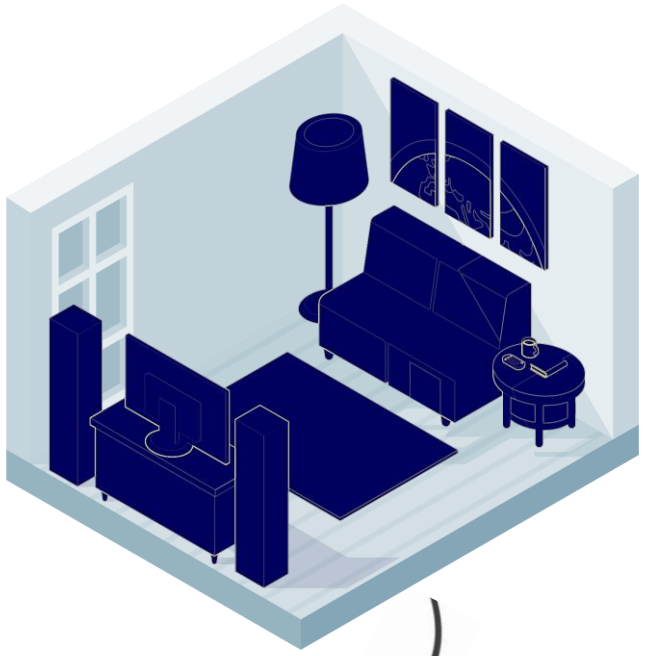
1. Create a country profile for Estonia in LADM Part 5

LADM proposes a **standardized structure** to store the “information” in a database…

… just like a **blueprint!**



“Bedroom”



“Living room”

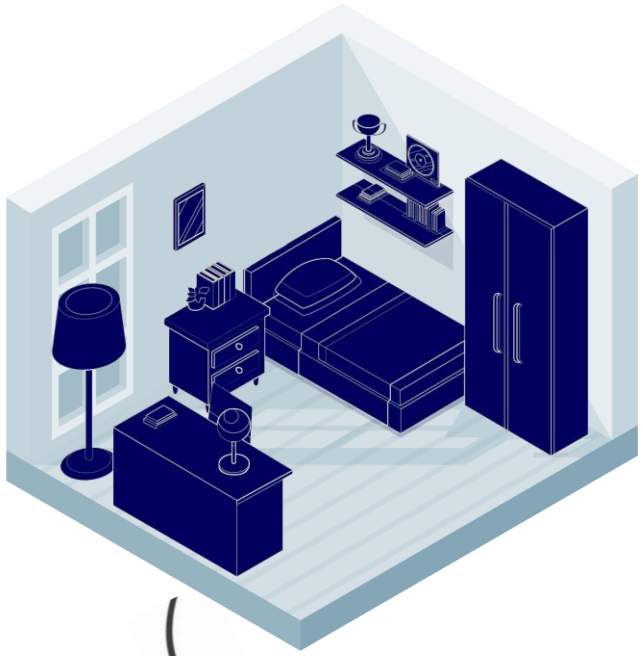
3. Estonia country profile

Why do we need a country profile?

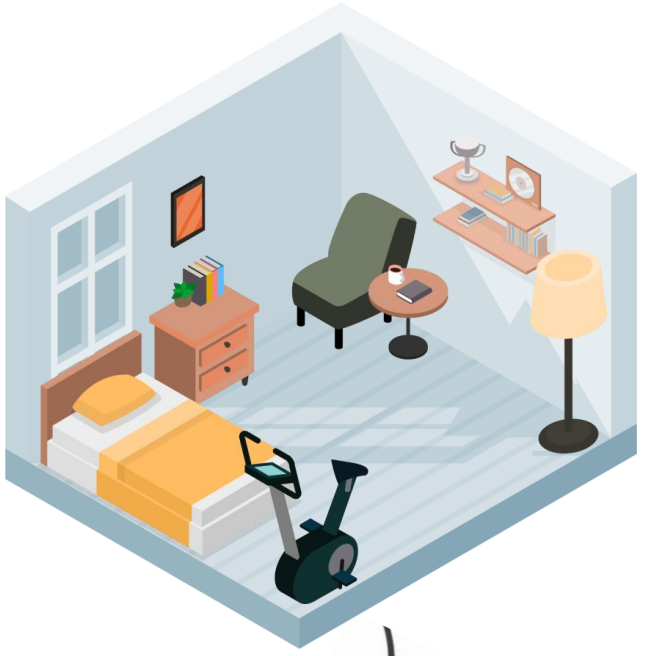
1. Create a country profile for Estonia in LADM Part 5

"LADM provides a guideline rather than rigid implementation methods"

This structure **can be rearranged according to the specific needs of a country.**



What LADM offers



Specific framework tailored to the needs of the country

3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

"LADM provides a guideline rather than rigid implementation methods"

Example:

- Inclusion of new things
- Minor changes to the locations
- Minor exclusions of unnecessary things

3. Estonia country profile

Why do we need a country profile?

1. Create a country profile for Estonia in LADM Part 5

In the end, we have a **standardized system** that works for us ***and*** **is also recognizable** by any other parties.

Promotes interoperability of the data!

3. Estonia country profile

What affected?

1. **The administrative system and the legal framework** of Estonia regarding spatial plans

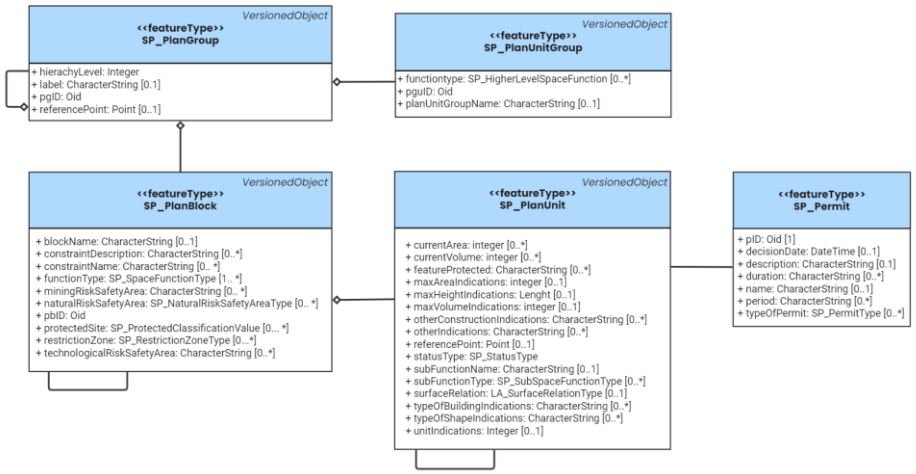
2. How each plan affects the other plan (**spatial plan hierarchy**)

3. **Data specific requirements** (e.g., layer requirements) to understand the data

4. **The existing database model's structure (PLANK)** for understanding what kind of data is stored from the plans and how they are used together

3. Estonia country profile

LADM P5

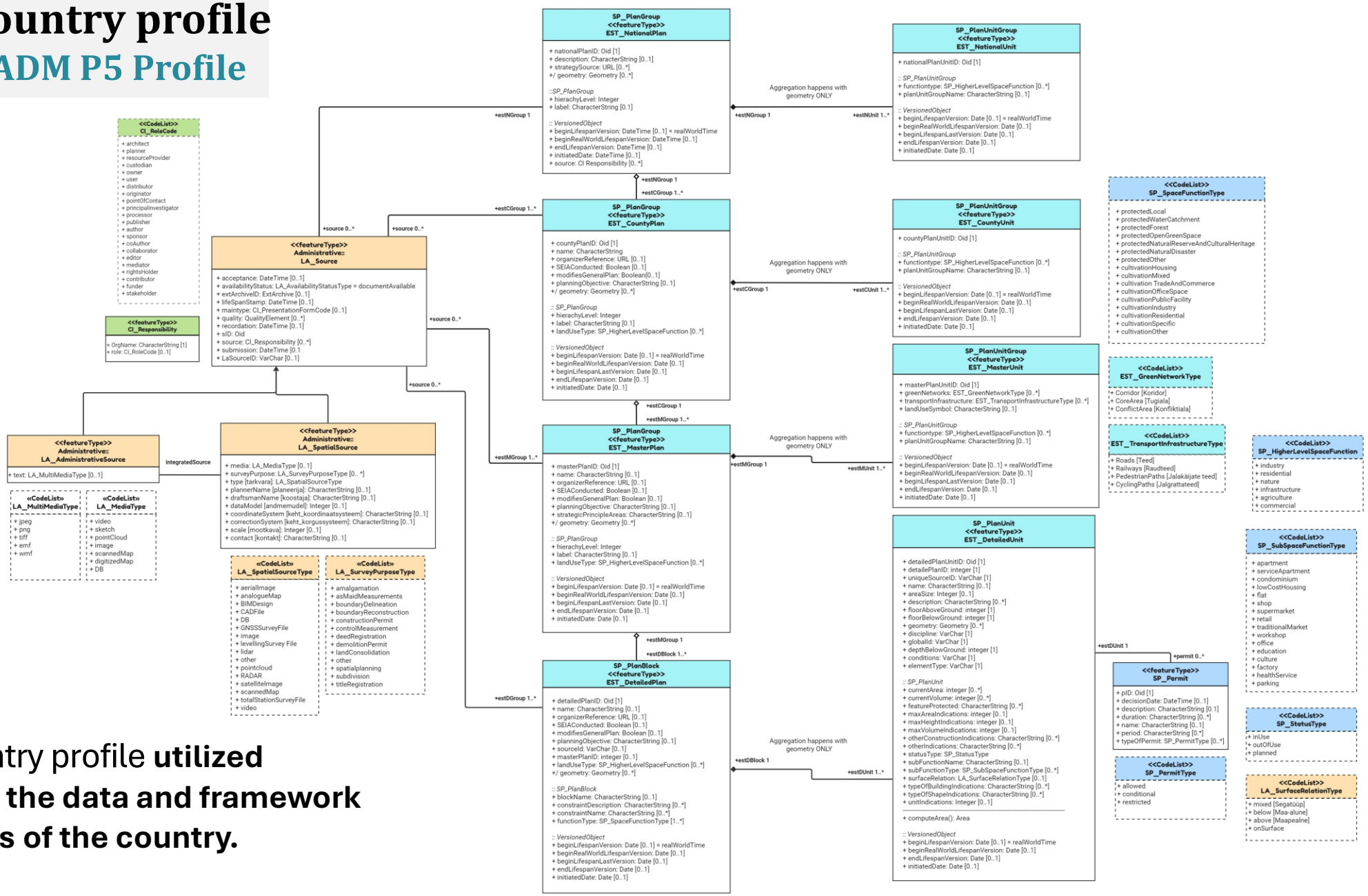


LADM P5's **proposed structure** to store the spatial information

(i.e., the **blueprint**)

3. Estonia country profile

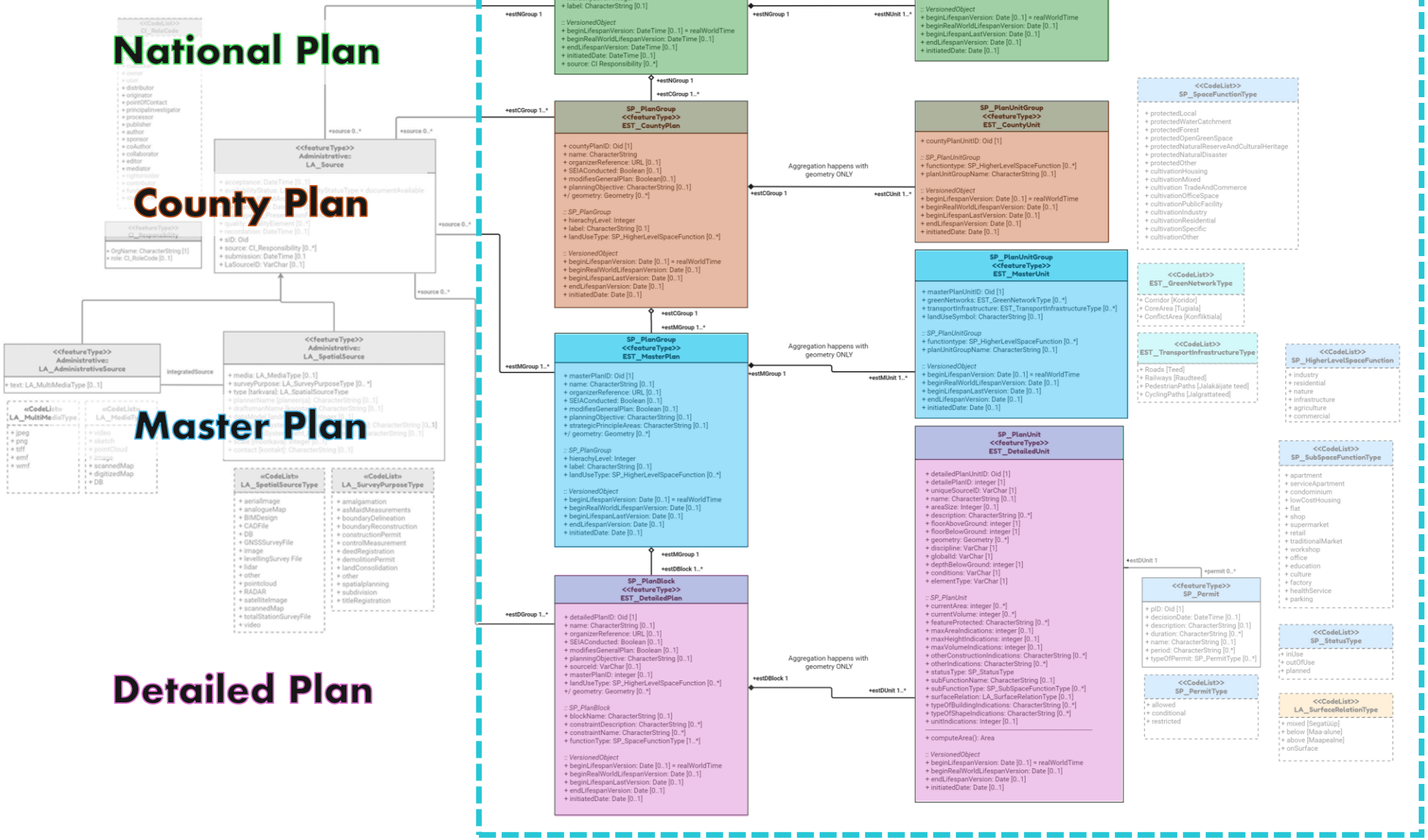
Estonia's LADM P5 Profile



Estonia country profile **utilized according to the data and framework requirements of the country.**

3. Estonia country profile

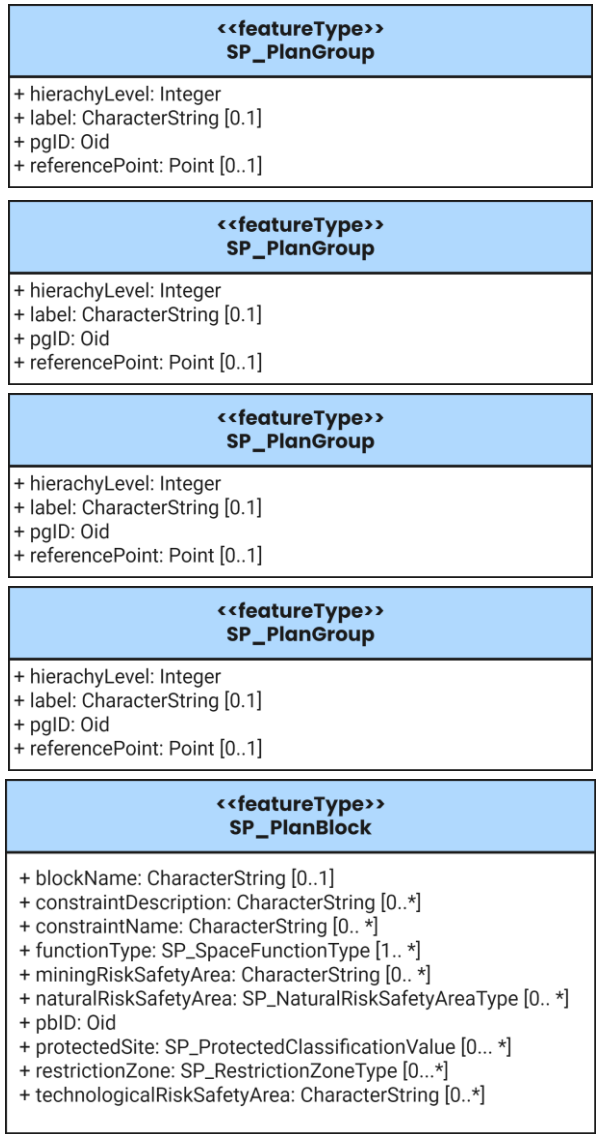
Plan Classes



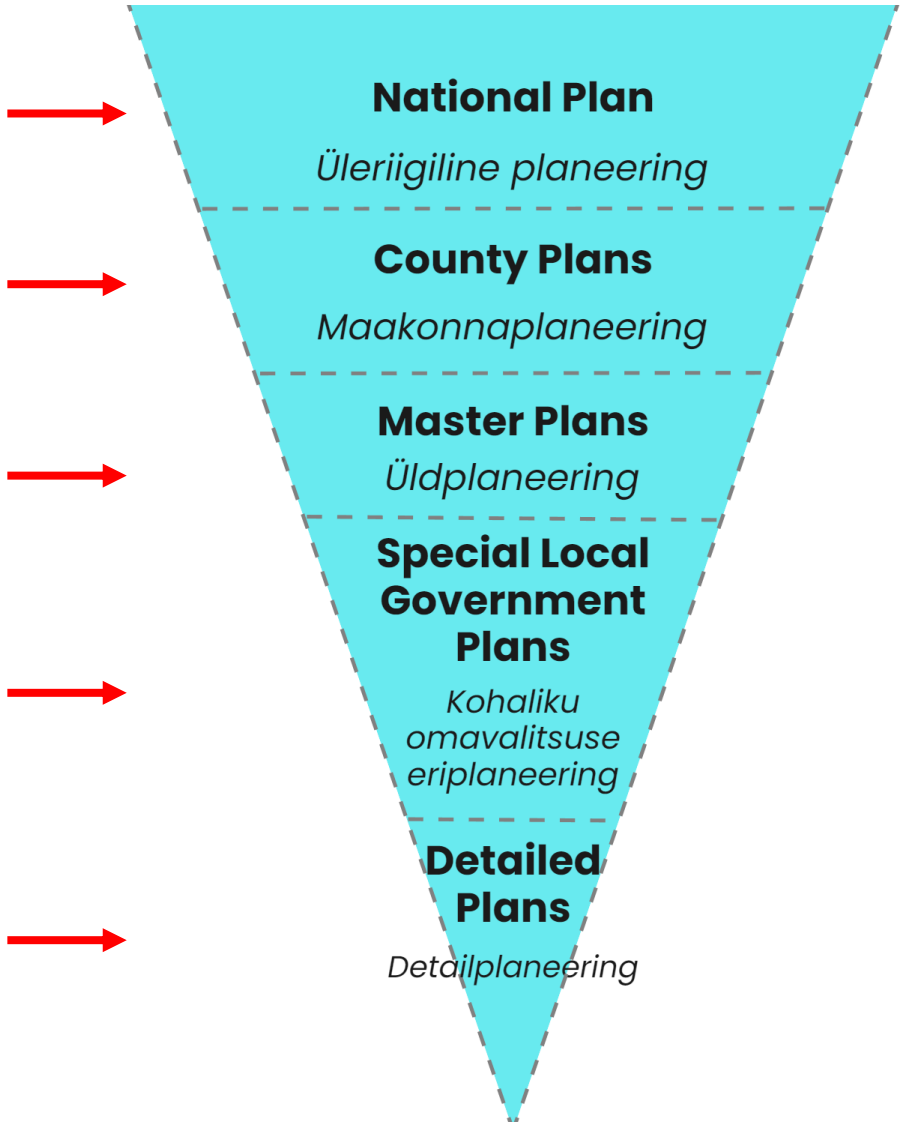
3. Estonia country profile

LADM Part 5 mapping

LADM Classes



Estonia Spatial Plans



3. Estonia country profile
LADM Part 5 mapping

For representing more details for each specific plan level…

<<featureType>>
SP_PlanUnit

+ currentArea: integer [0..*]
+ currentVolume: integer [0..*]
+ featureProtected: CharacterString [0..*]
+ maxAreaIndications: integer [0..1]
+ maxHeightIndications: Lenght [0..1]
+ maxVolumeIndications: integer [0..1]
+ otherConstructionIndications: CharacterString [0..*]
+ otherIndications: CharacterString [0..*]
+ referencePoint: Point [0..1]
+ statusType: SP_StatusType
+ subFunctionName: CharacterString [0..1]
+ subFunctionType: SP_SubSpaceFunctionType [0..*]
+ surfaceRelation: LA_SurfaceRelationType [0..1]
+ typeOfBuildingIndications: CharacterString [0..*]
+ typeOfShapeIndications: CharacterString [0..*]
+ unitIndications: Integer [0..1]

LADM Classes

<<featureType>>
SP_PlanGroup

+ hierachyLevel: Integer
+ label: CharacterString [0.1]
+ pgID: Oid
+ referencePoint: Point [0..1]

<<featureType>>
SP_PlanGroup

+ hierachyLevel: Integer
+ label: CharacterString [0.1]
+ pgID: Oid
+ referencePoint: Point [0..1]

<<featureType>>
SP_PlanGroup

+ hierachyLevel: Integer
+ label: CharacterString [0.1]
+ pgID: Oid
+ referencePoint: Point [0..1]

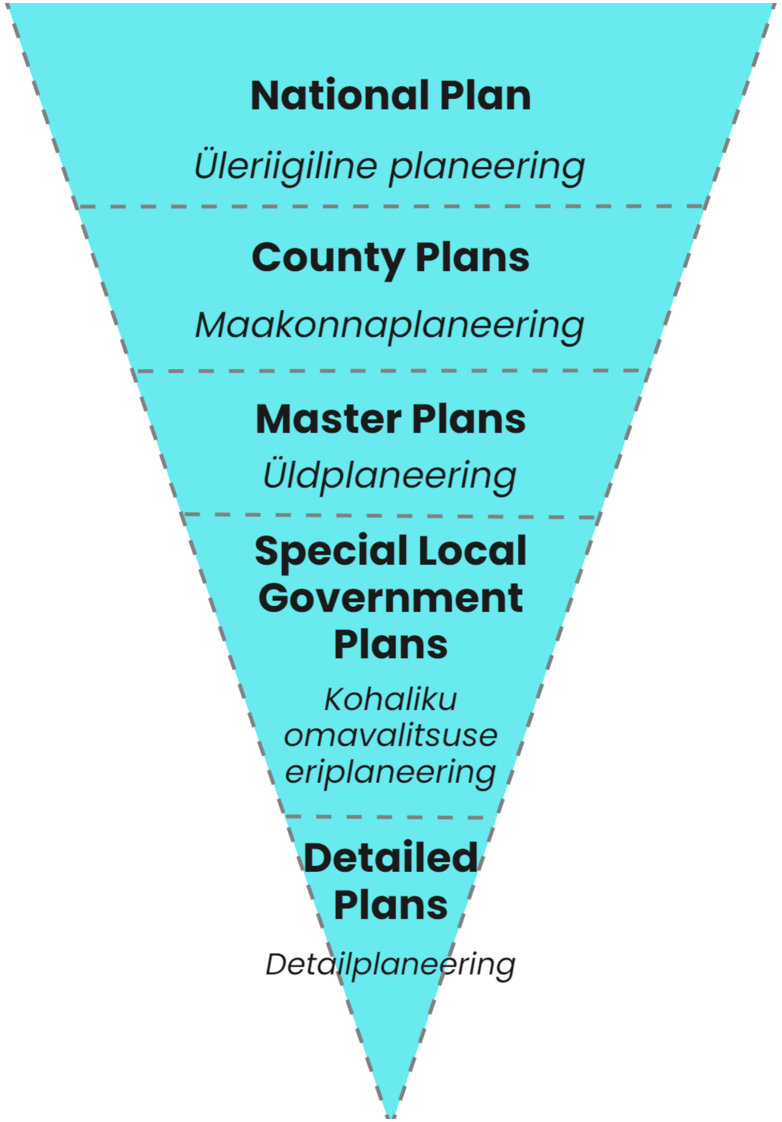
<<featureType>>
SP_PlanGroup

+ hierachyLevel: Integer
+ label: CharacterString [0.1]
+ pgID: Oid
+ referencePoint: Point [0..1]

<<featureType>>
SP_PlanBlock

+ blockName: CharacterString [0..1]
+ constraintDescription: CharacterString [0..*]
+ constraintName: CharacterString [0.. *]
+ functionType: SP_SpaceFunctionType [1.. *]
+ miningRiskSafetyArea: CharacterString [0.. *]
+ naturalRiskSafetyArea: SP_NaturalRiskSafetyAreaType [0.. *]
+ pbID: Oid
+ protectedSite: SP_ProtectedClassificationValue [0... *]
+ restrictionZone: SP_RestrictionZoneType [0...*]
+ technologicalRiskSafetyArea: CharacterString [0..*]

Estonia Spatial Plans



3. Estonia country profile

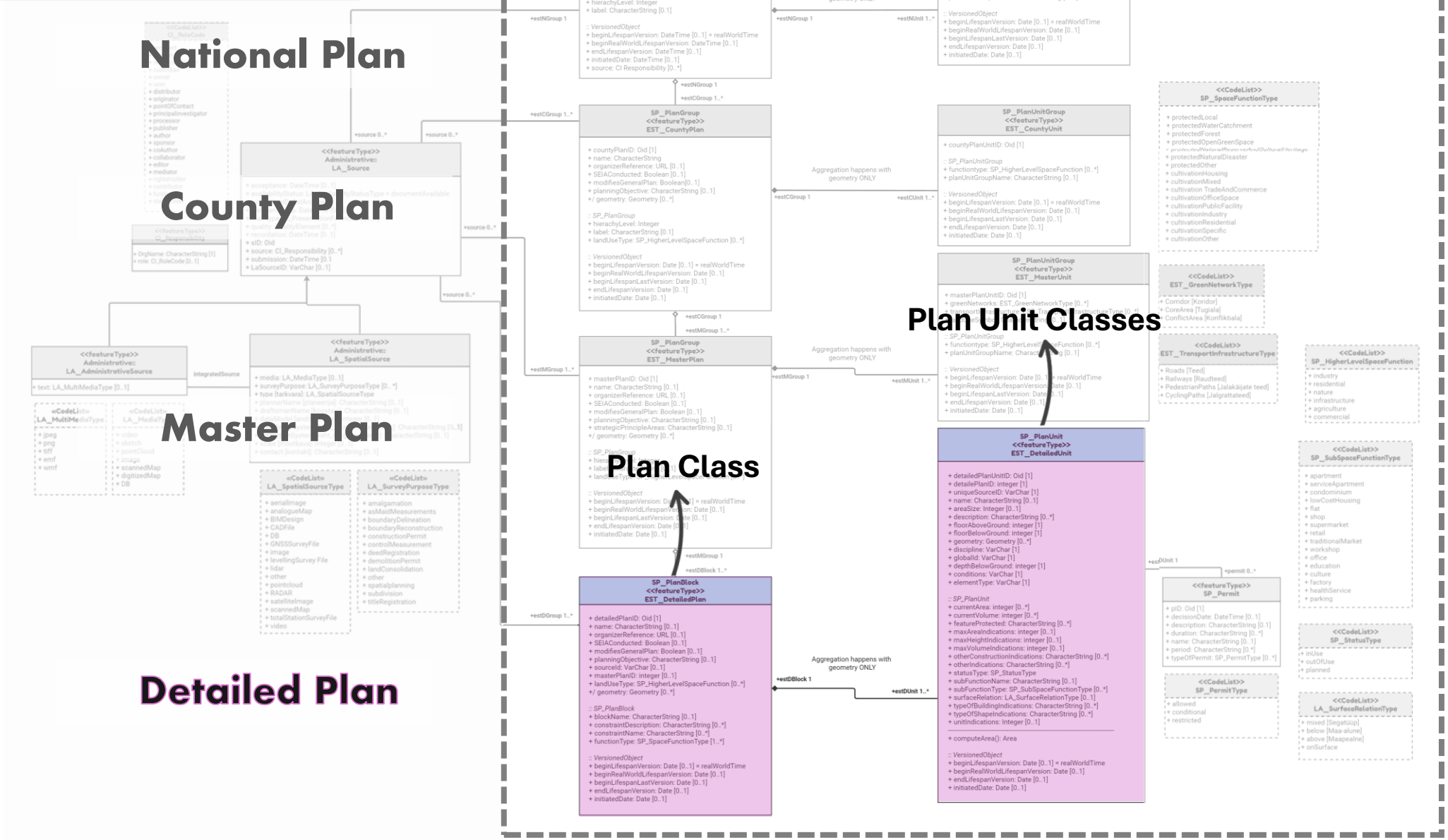
Plan Classes

National Plan

County Plan

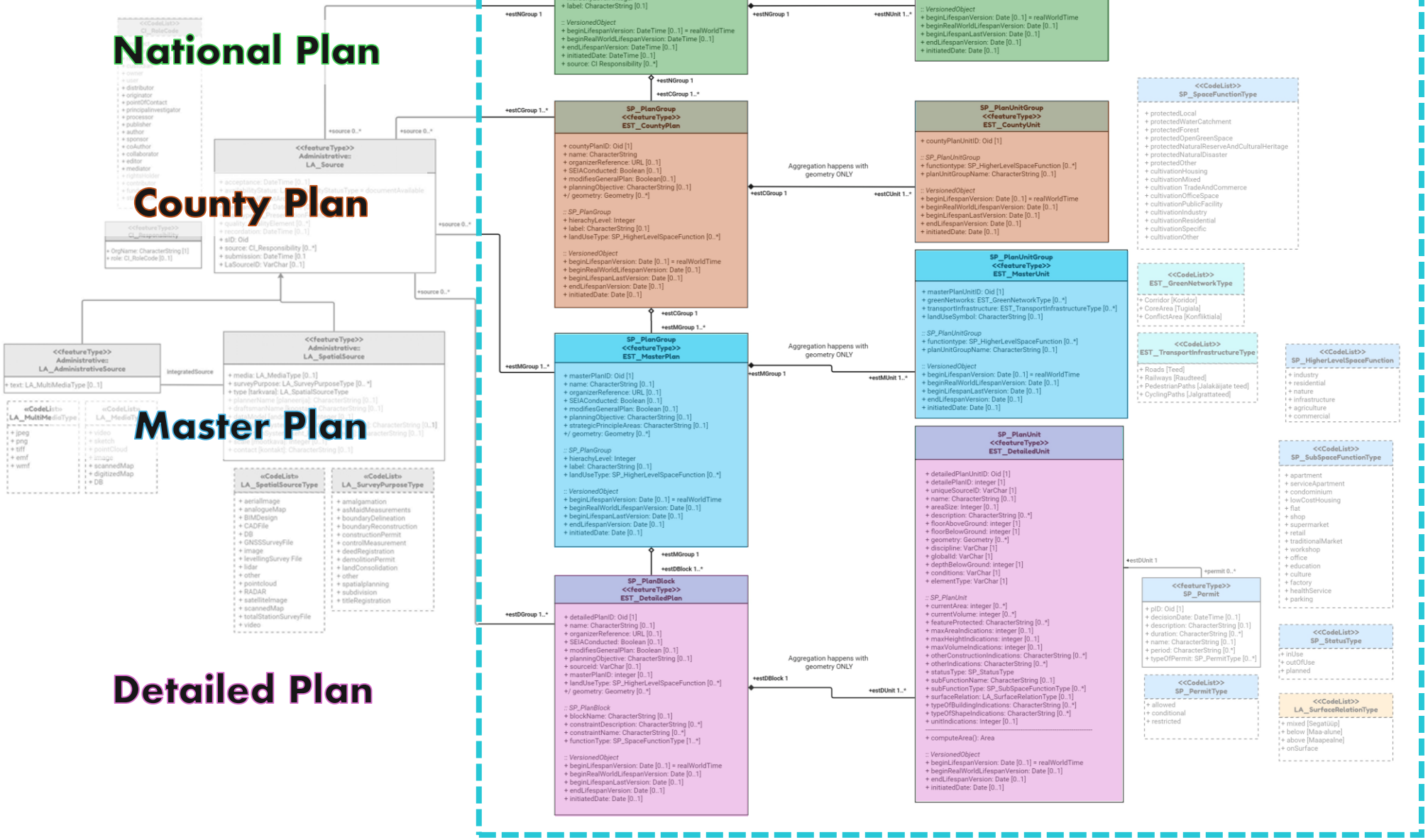
Master Plan

Detailed Plan



3. Estonia country profile

Plan Classes

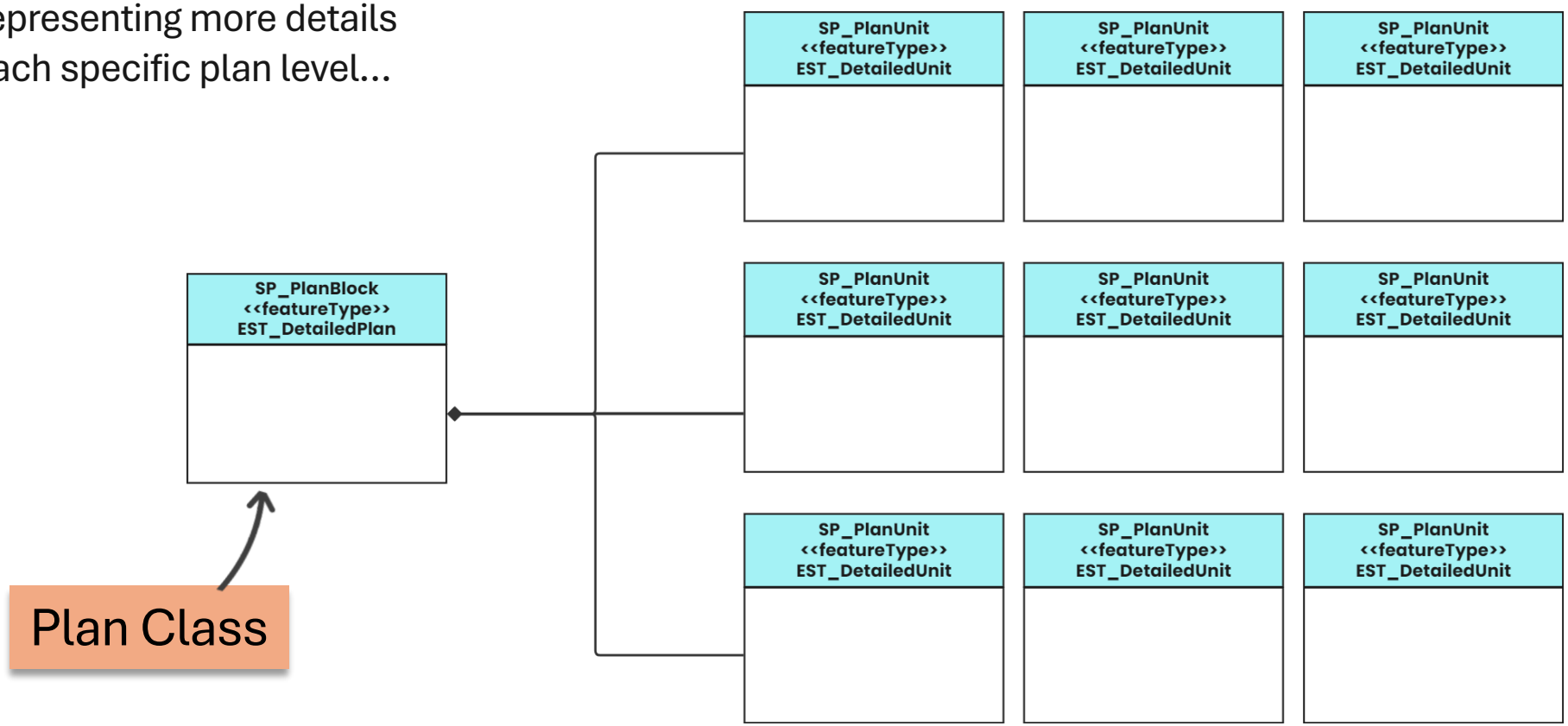


3. Estonia country profile

LADM Part 5 mapping

its unit classes

For representing more details for each specific plan level...



3. Estonia country profile

LADM Part 5 mapping

its unit classes

For representing more details
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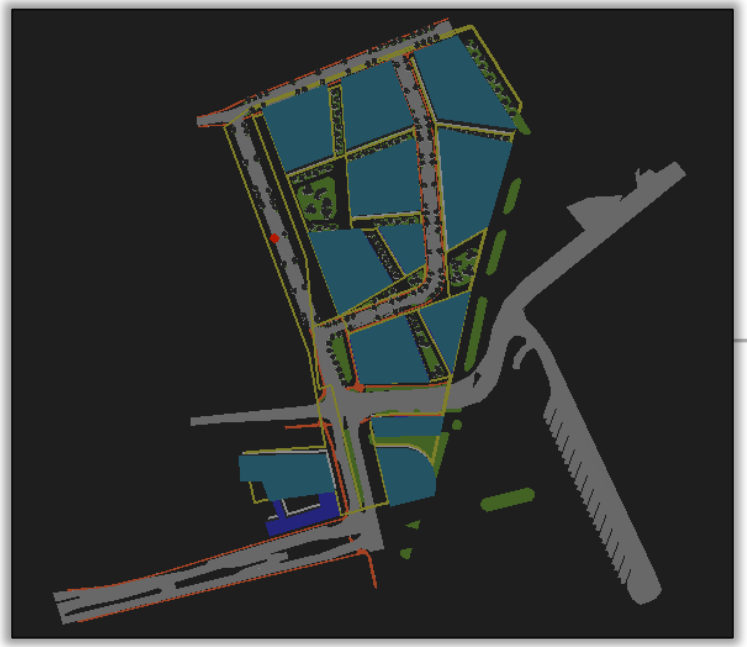
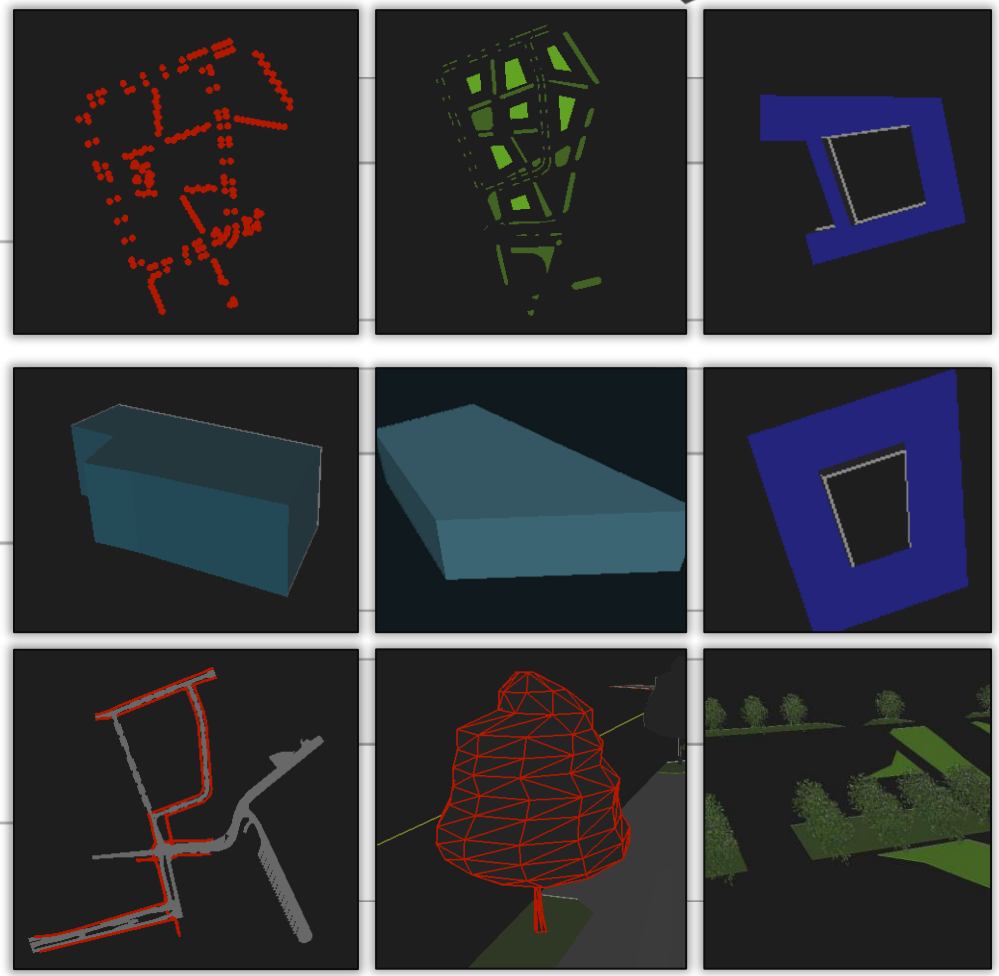
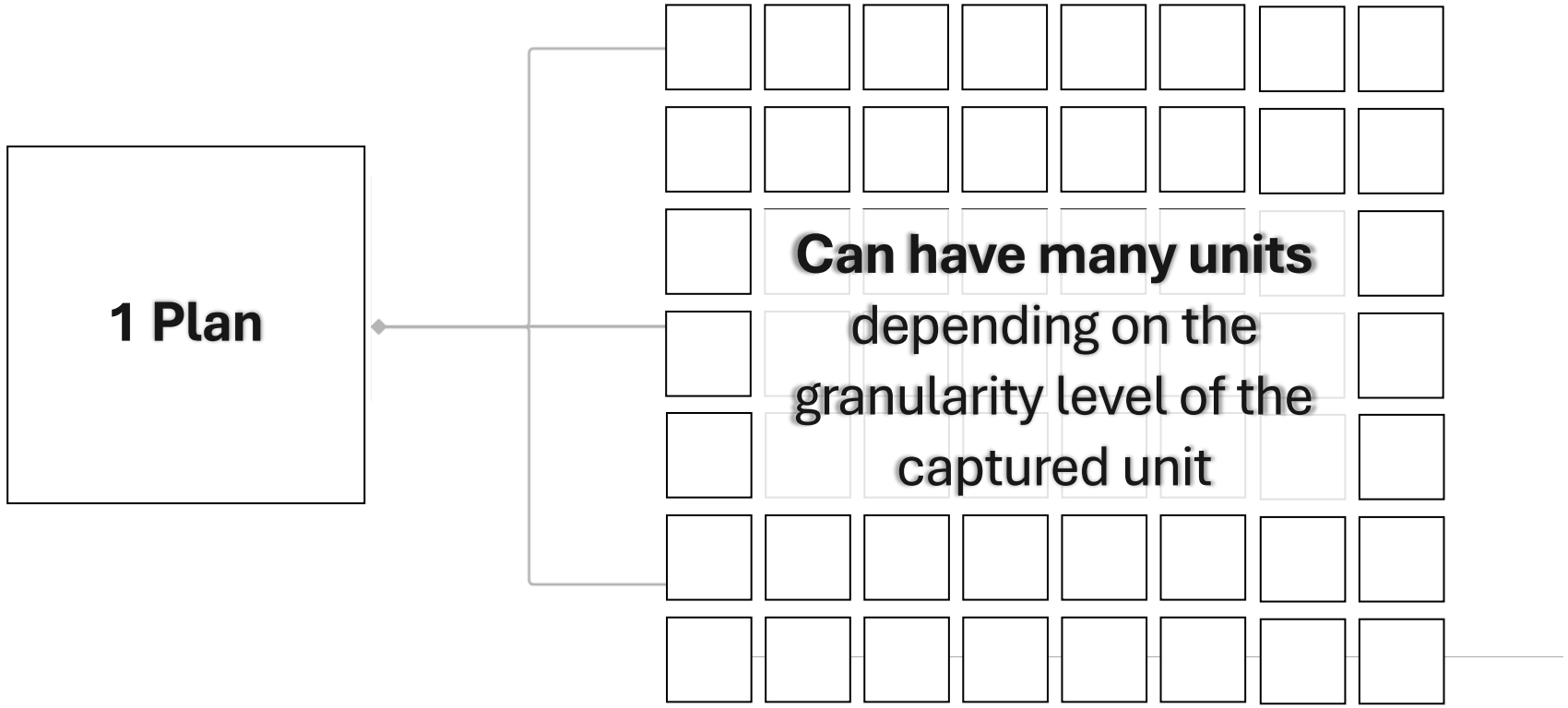




3. Estonia country profile

LADM Part 5 mapping

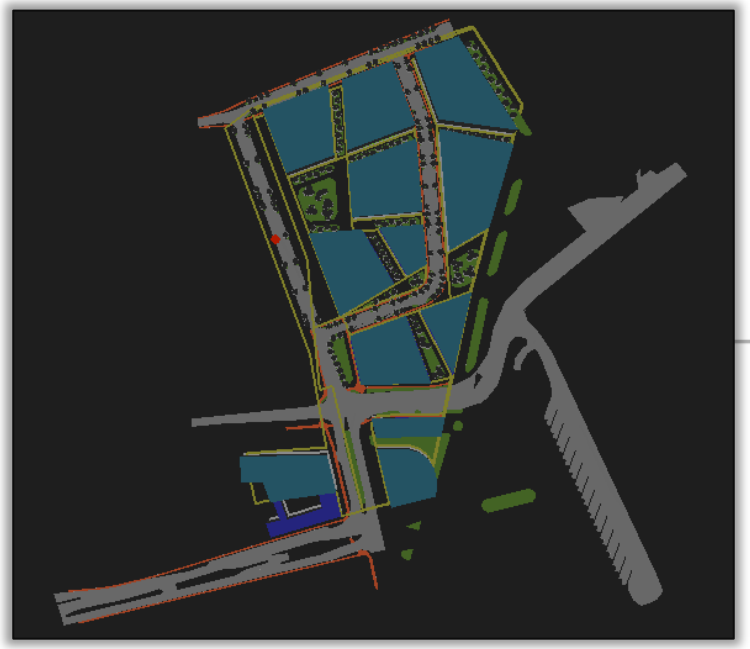
So…



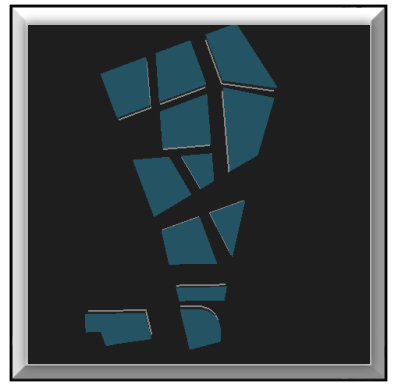
3. Estonia country profile

LADM Part 5 mapping

So, a unit can be

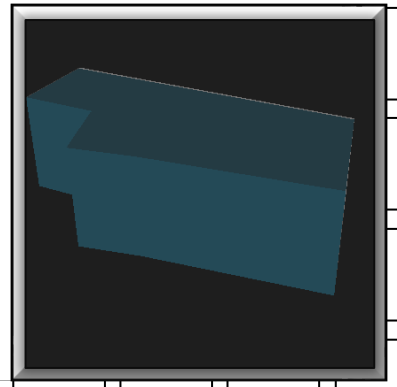


the whole built environment



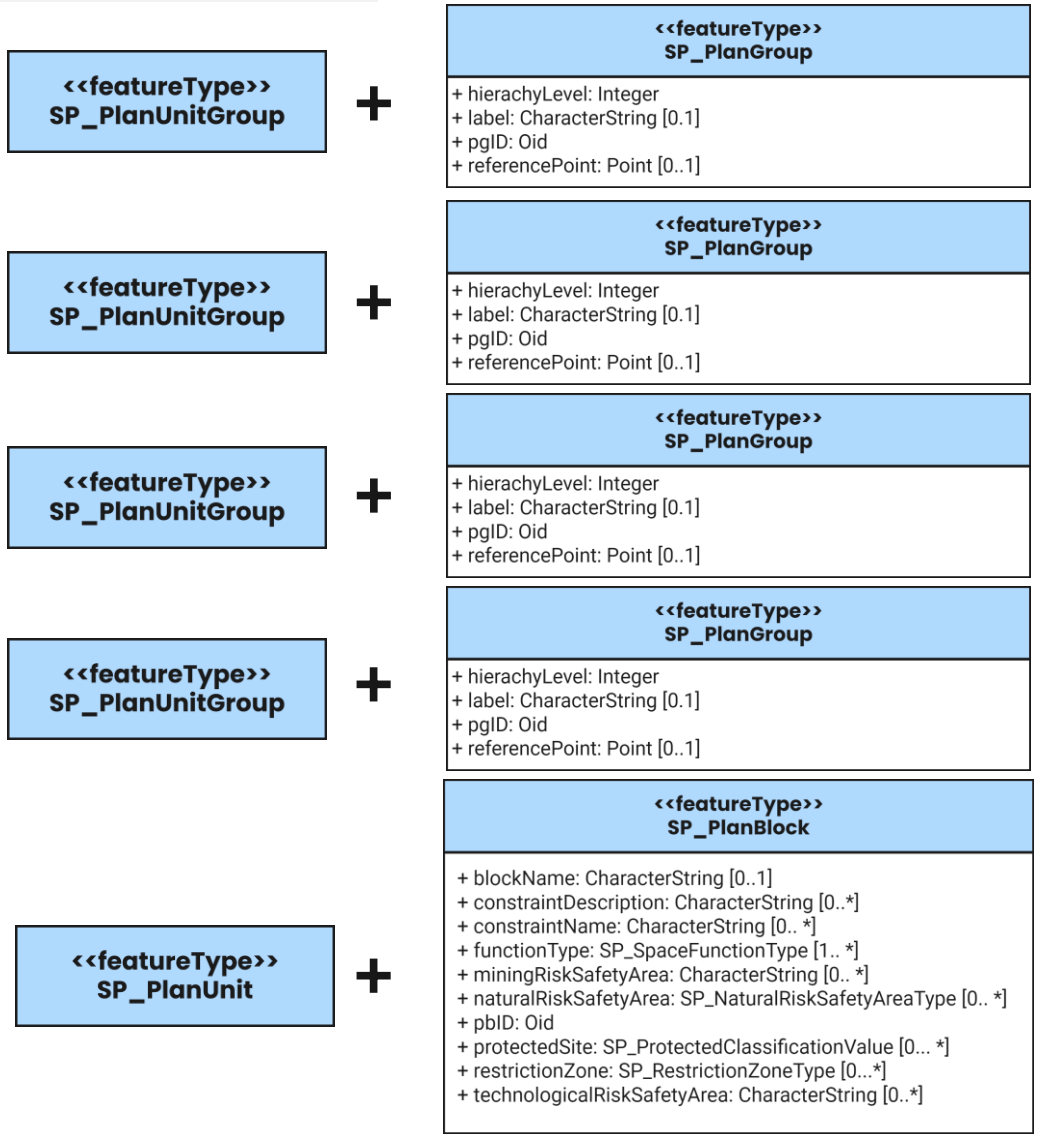
OR/AND

one building



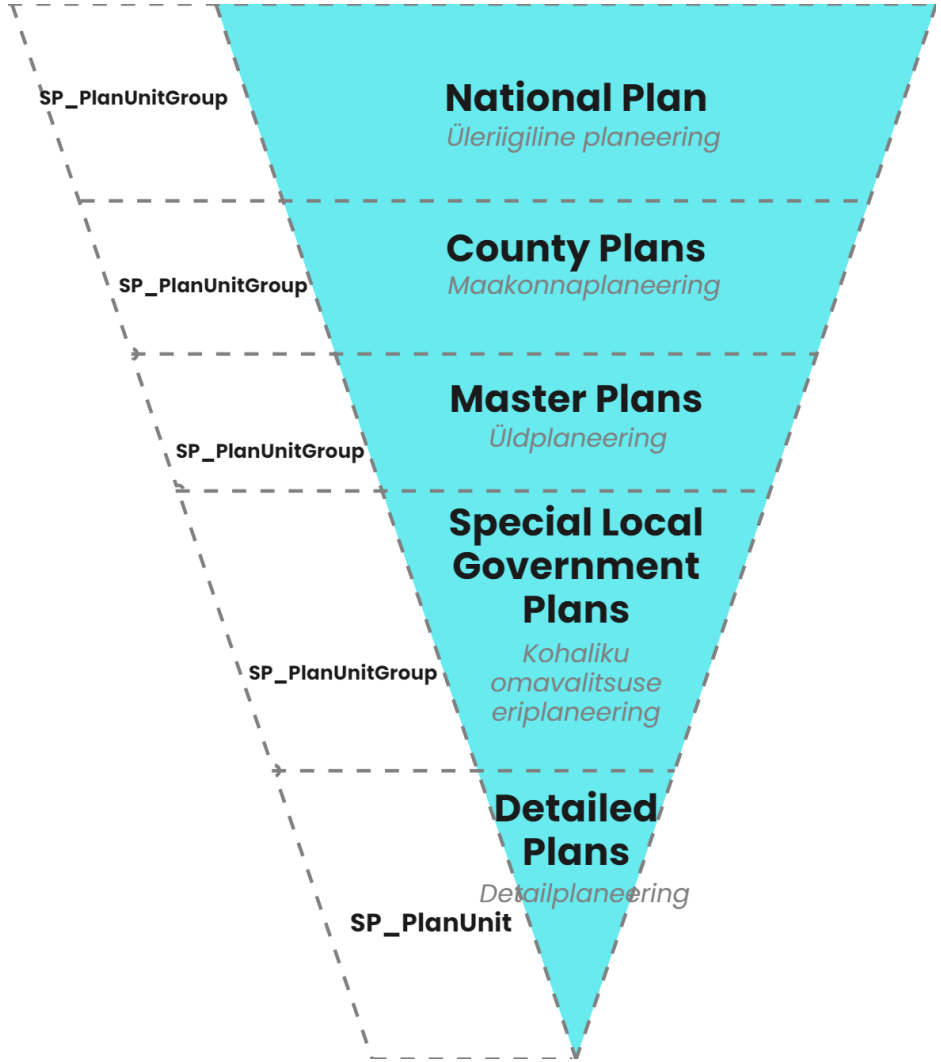
3. Estonia country profile

LADM Part 5 mapping



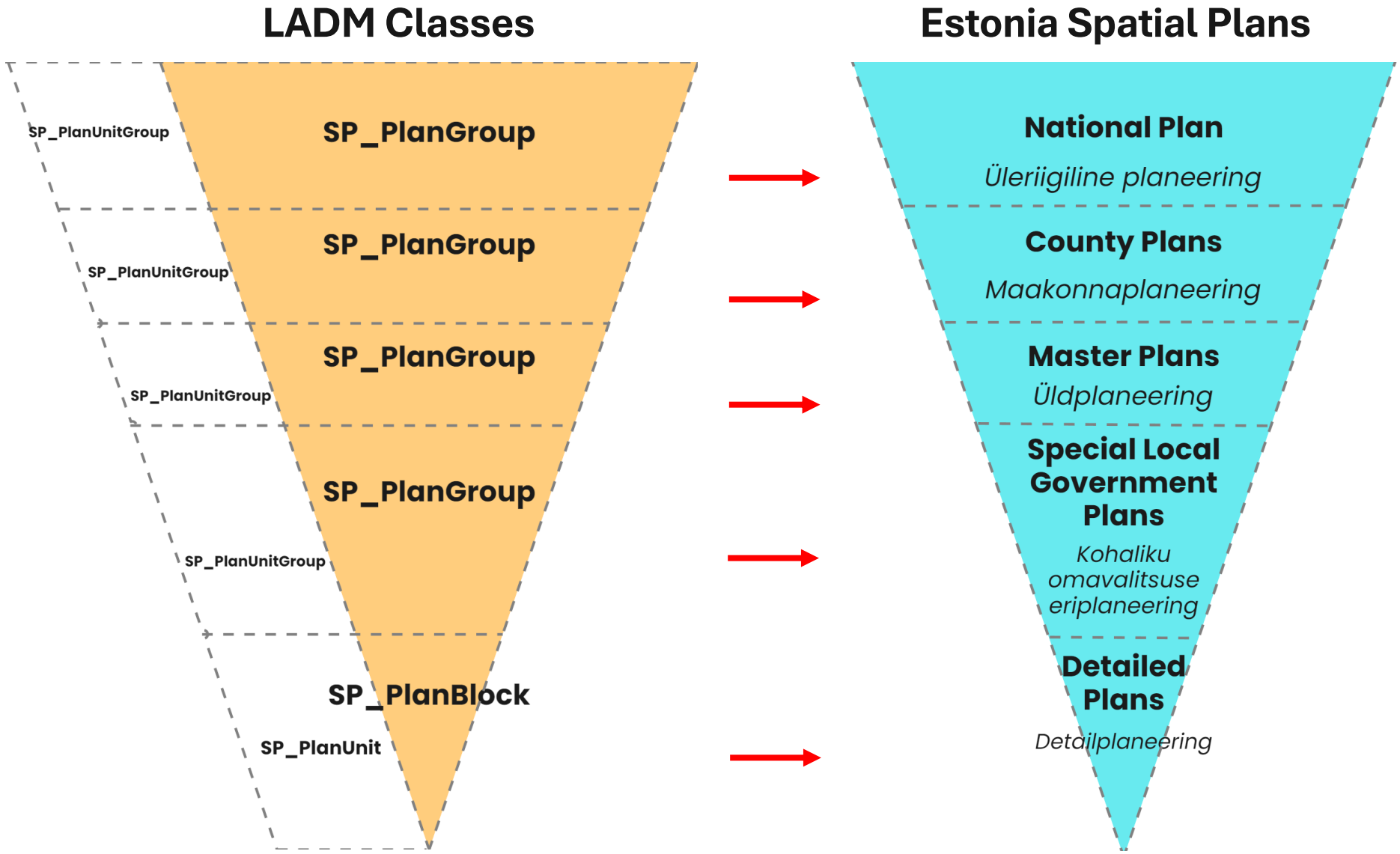
LADM Classes

Estonia Spatial Plans



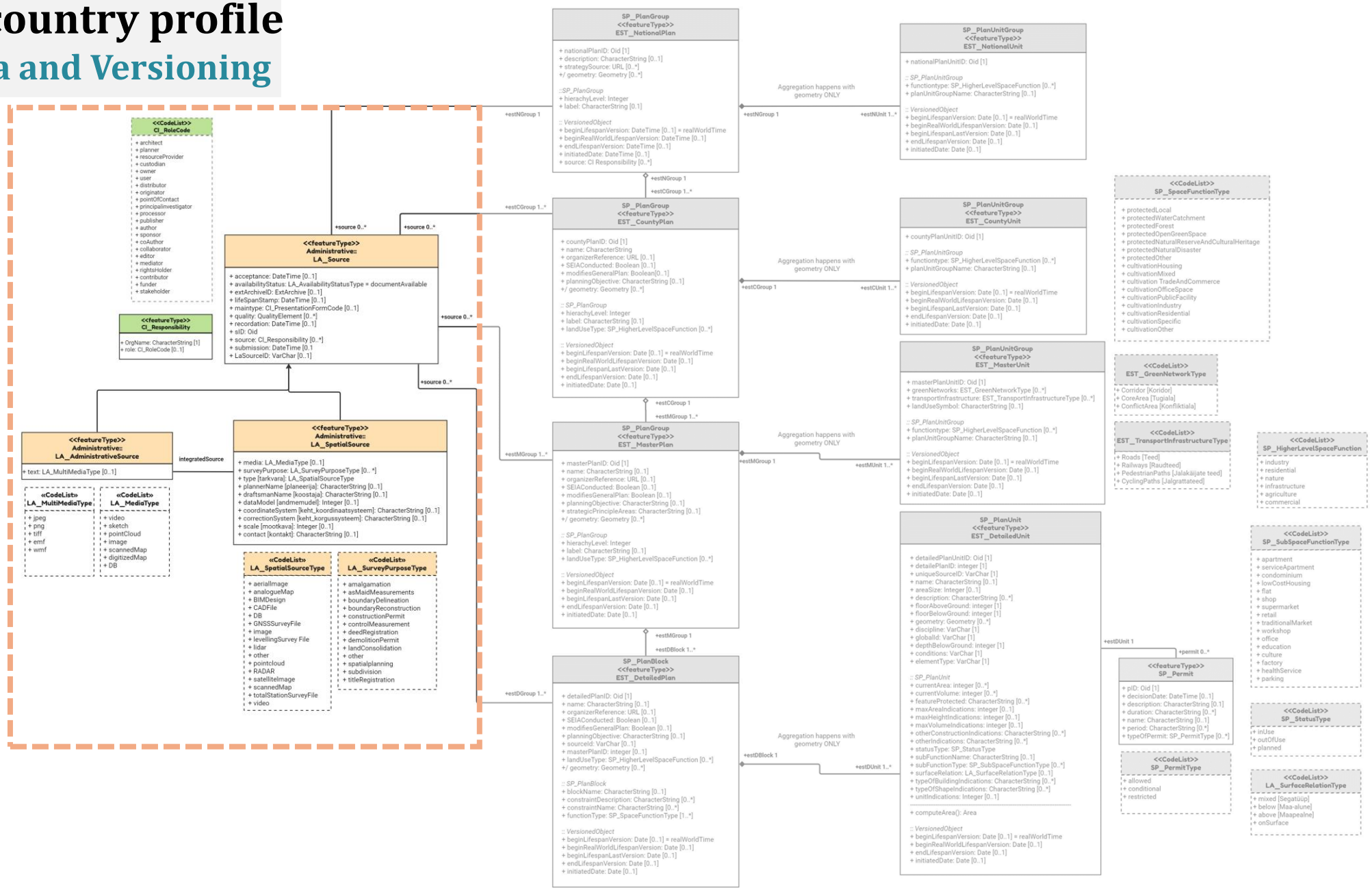
3. Estonia country profile

LADM Part 5 mapping



3. Estonia country profile

Metadata and Versioning

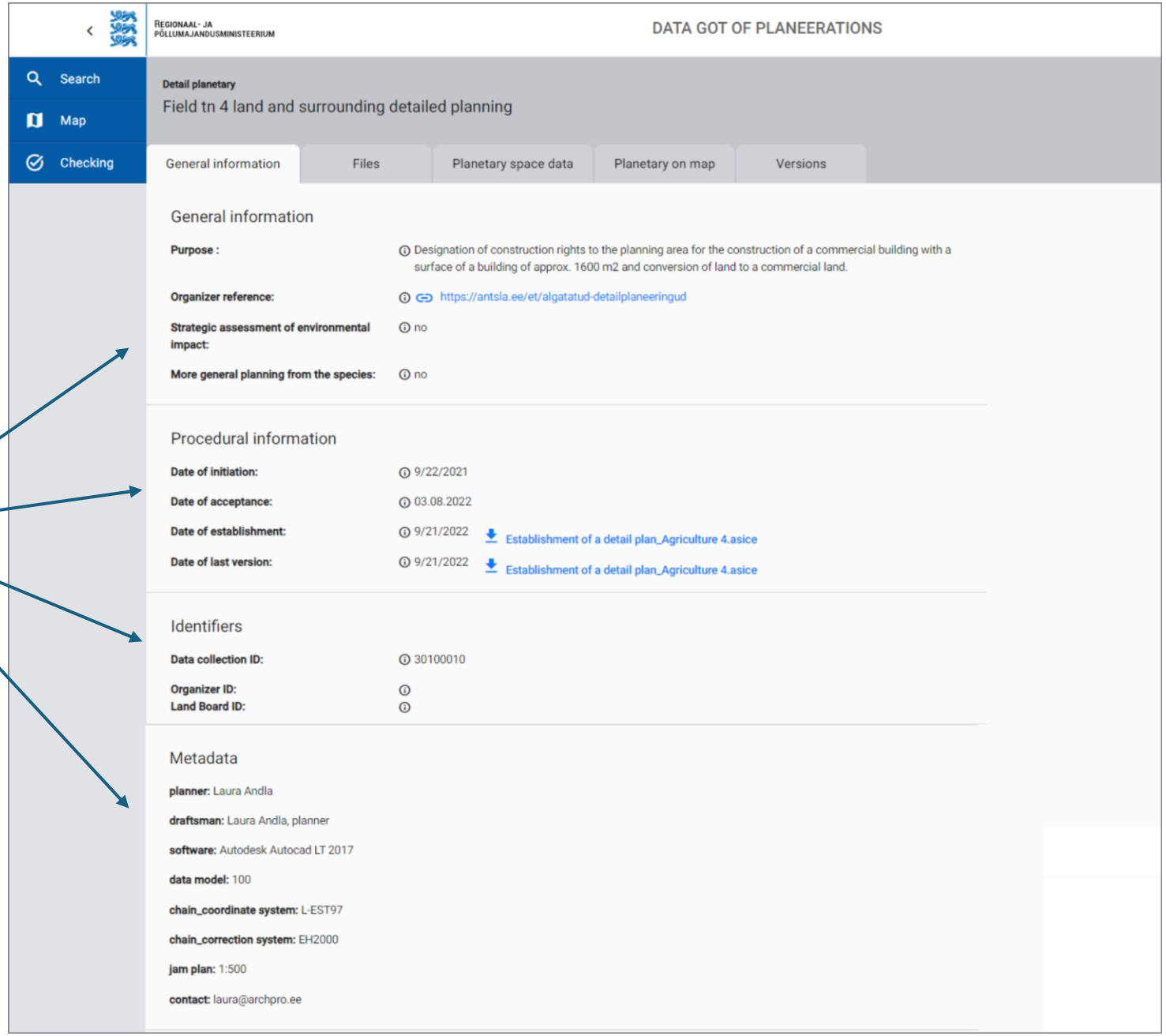


3. Estonia country profile

Metadata and Versioning

Mostly developed according to the additional information PLANK offers

PLANK

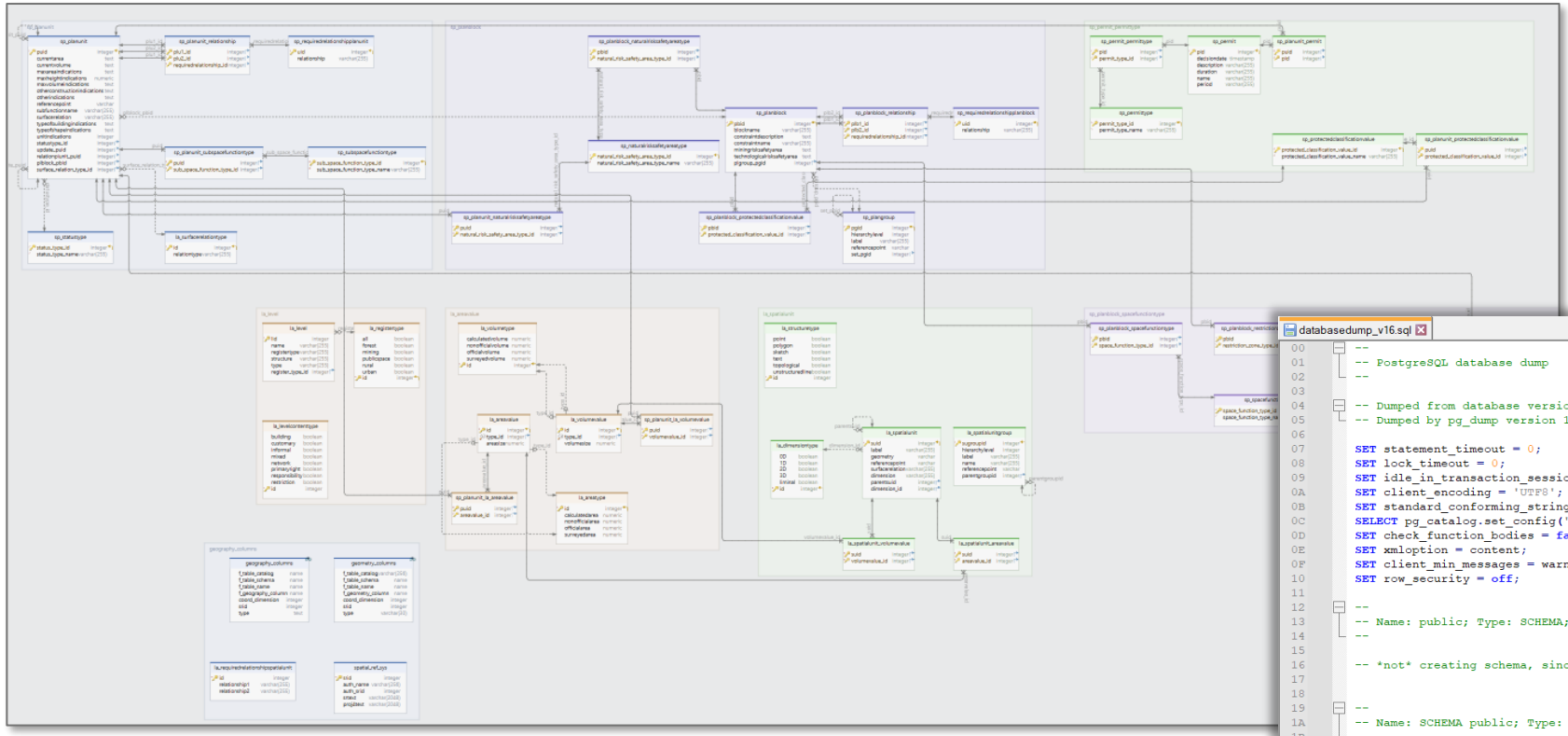


4. Implementation

1. Create a country profile for Estonia in LADM Part 5
2. Create and use the LADM database to store data
3. Develop an import script to import plans to the database
4. Integration with the compliance checks

4. Implementation

LADM Database Setup



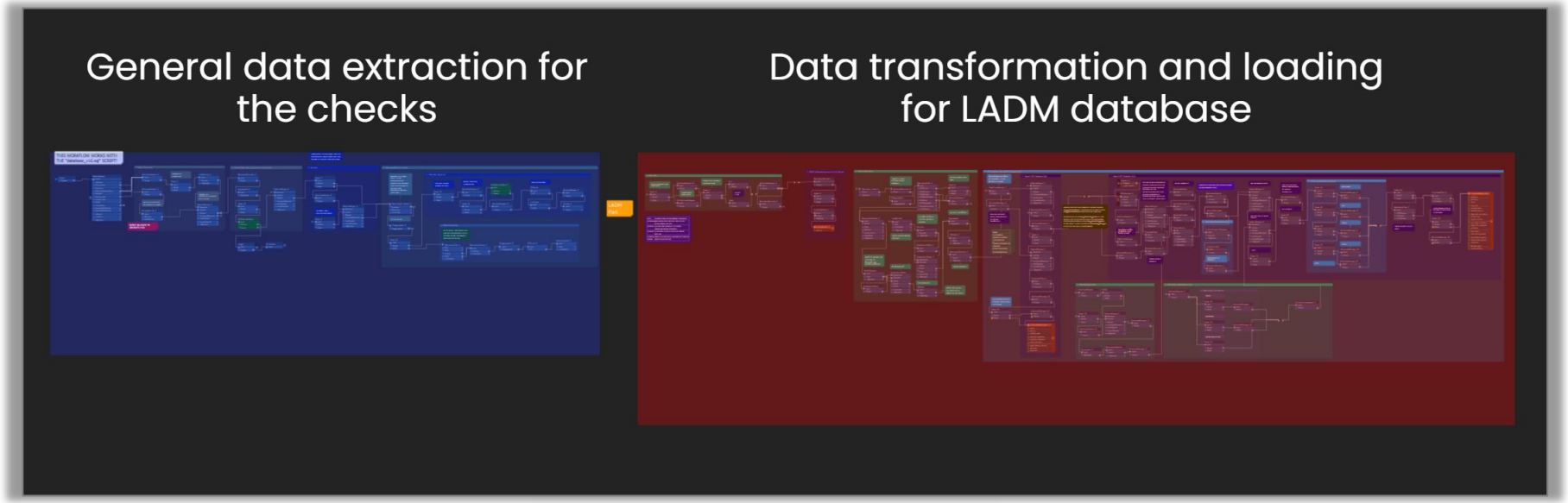
databasedump_v16.sql

```
--
-- PostgreSQL database dump
--

-- Dumped from database version 16.1
-- Dumped by pg_dump version 16.1

SET statement_timeout = 0;
SET lock_timeout = 0;
SET idle_in_transaction_session_timeout = 0;
SET client_encoding = 'UTF8';
SET standard_conforming_strings = on;
SELECT pg_catalog.set_config('search_path', '', false);
SET check_function_bodies = false;
SET xmloption = content;
SET client_min_messages = warning;
SET row_security = off;

--
-- Name: public; Type: SCHEMA; Schema: -; Owner: -
--

-- *not* creating schema, since initdb creates it


--
-- Name: SCHEMA public; Type: COMMENT; Schema: -; Owner: -
--

COMMENT ON SCHEMA public IS '';


--
-- Name: postgis; Type: EXTENSION; Schema: -; Owner: -
--

CREATE EXTENSION IF NOT EXISTS postgis WITH SCHEMA public;


--
-- Name: EXTENSION postgis; Type: COMMENT; Schema: -; Owner: -
--

COMMENT ON EXTENSION postgis IS 'PostGIS geometry and geography spatial types and functions';


--
-- Name: get_triggers(); Type: FUNCTION; Schema: public; Owner: -
```

Creation of a database in PostgreSQL of the new Estonia profile in LADM

4. Implementation

Import Plans to the Database



PLAN data
(IFC)

Mapping IFC attributes to classes/attributes in LADM database

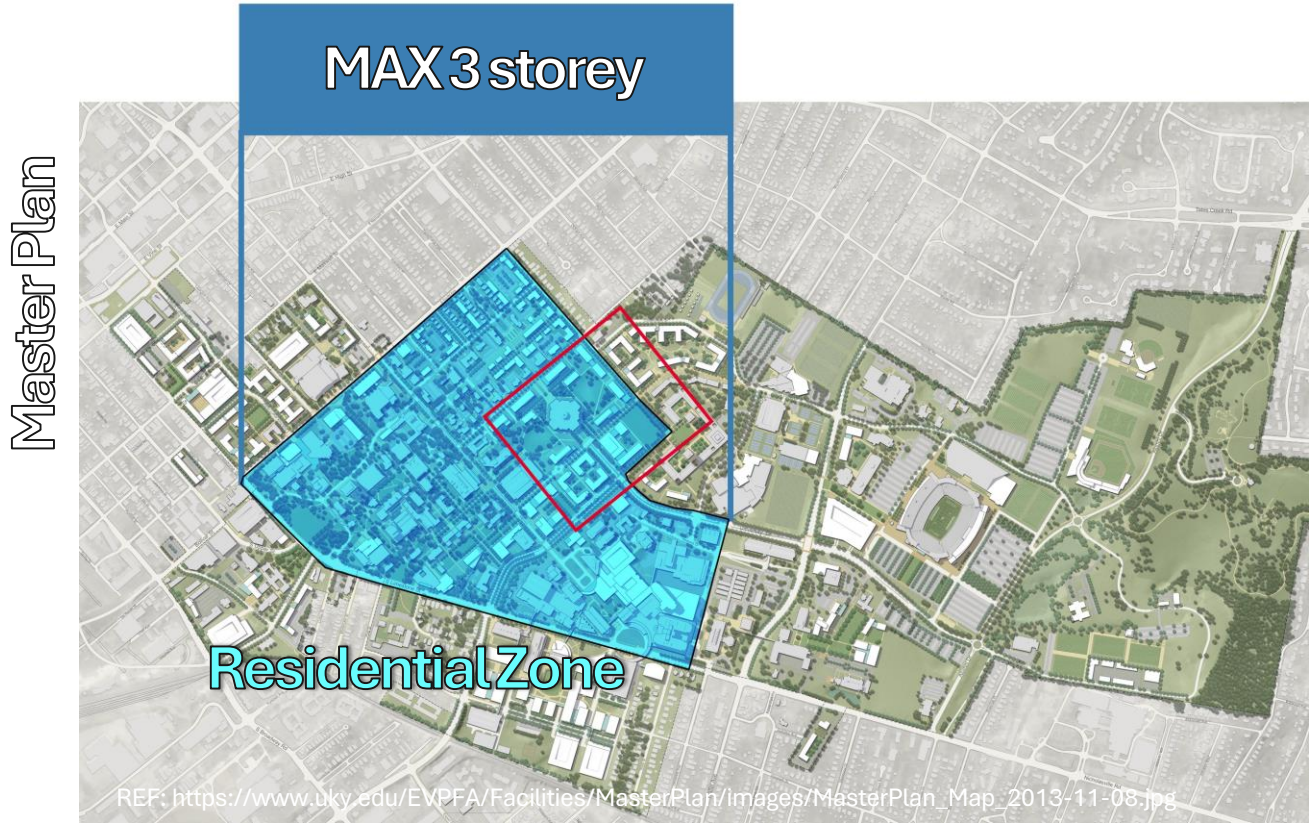
LADM P5 Database

4. Implementation

Compliance Checks: *Example*

“The height of the buildable area in Detailed Plan cannot exceed the max. height of the Master Plan”

1. Upload an IFC file of the Detailed Plan and access required Master Plan data
2. Check if the model fits the IDS requirements (ensuring that information is in the correct location and format)
3. Compute the checks



4. Implementation

Compliance Checks: *Example*

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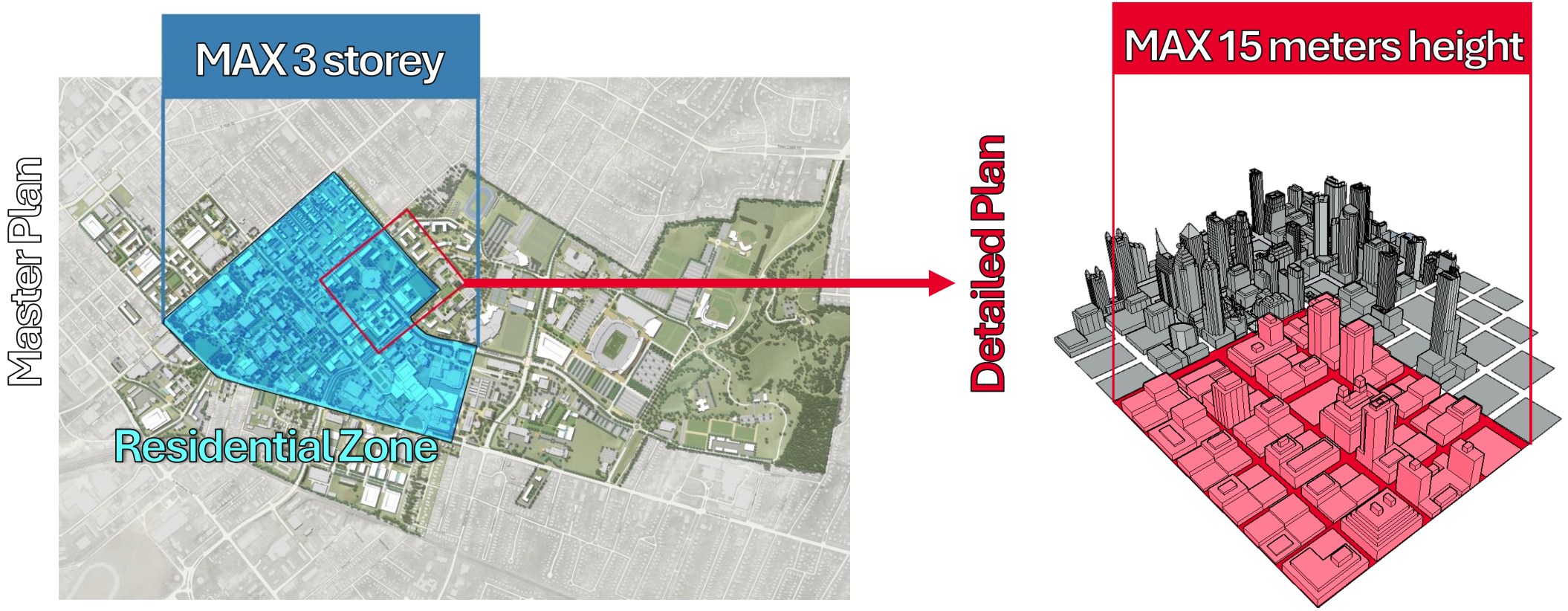
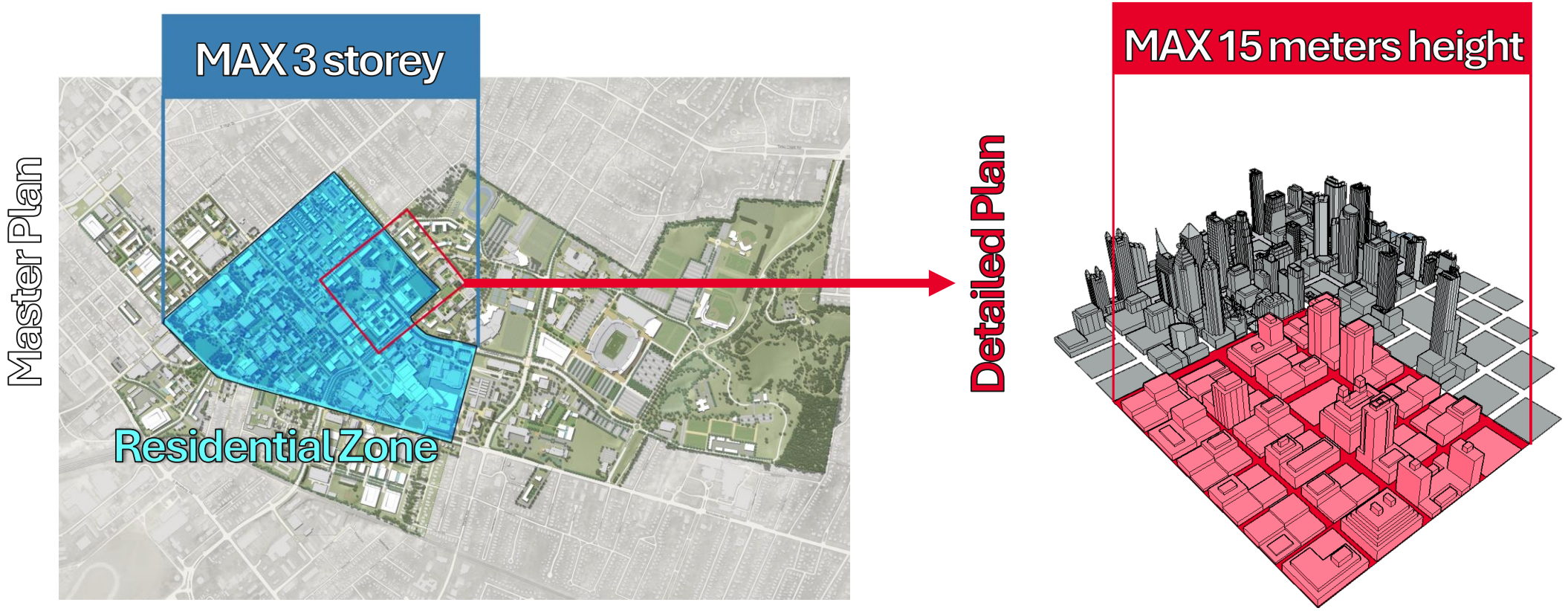


4. Implementation

Compliance Checks: *Example*

Does the Detail Plan comply against Master Plan regulations?

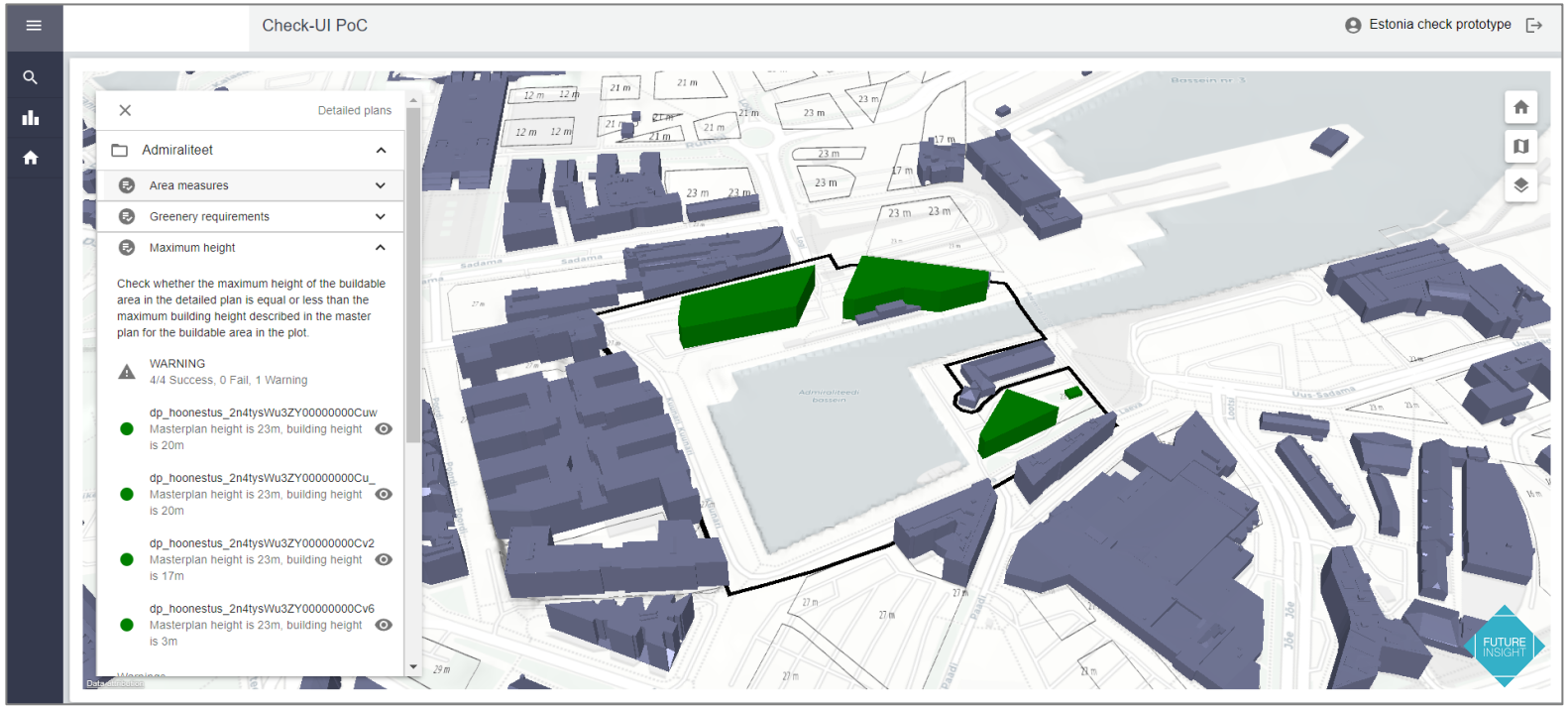


4. Implementation

Compliance Checks: *Example*

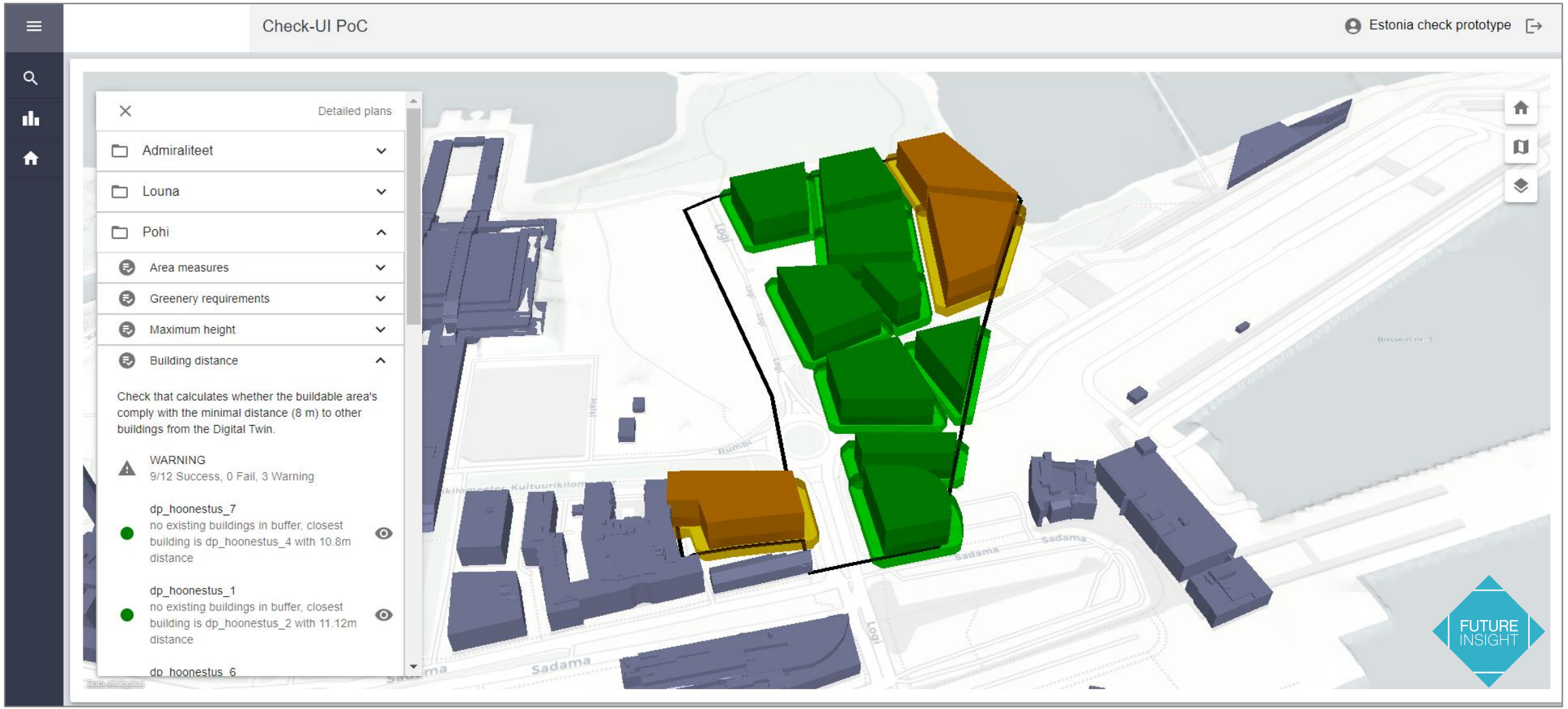
“The height of the buildable area in Detailed Plan cannot exceed the max. height of the Master Plan”

1. Upload an IFC file of the Detailed Plan and access required Master Plan data
2. Check if the model fits the IDS requirements (ensuring that information is in the correct location and format)
3. Compute the checks
4. **Visualize the results** of the pre-defined detailed plan checks



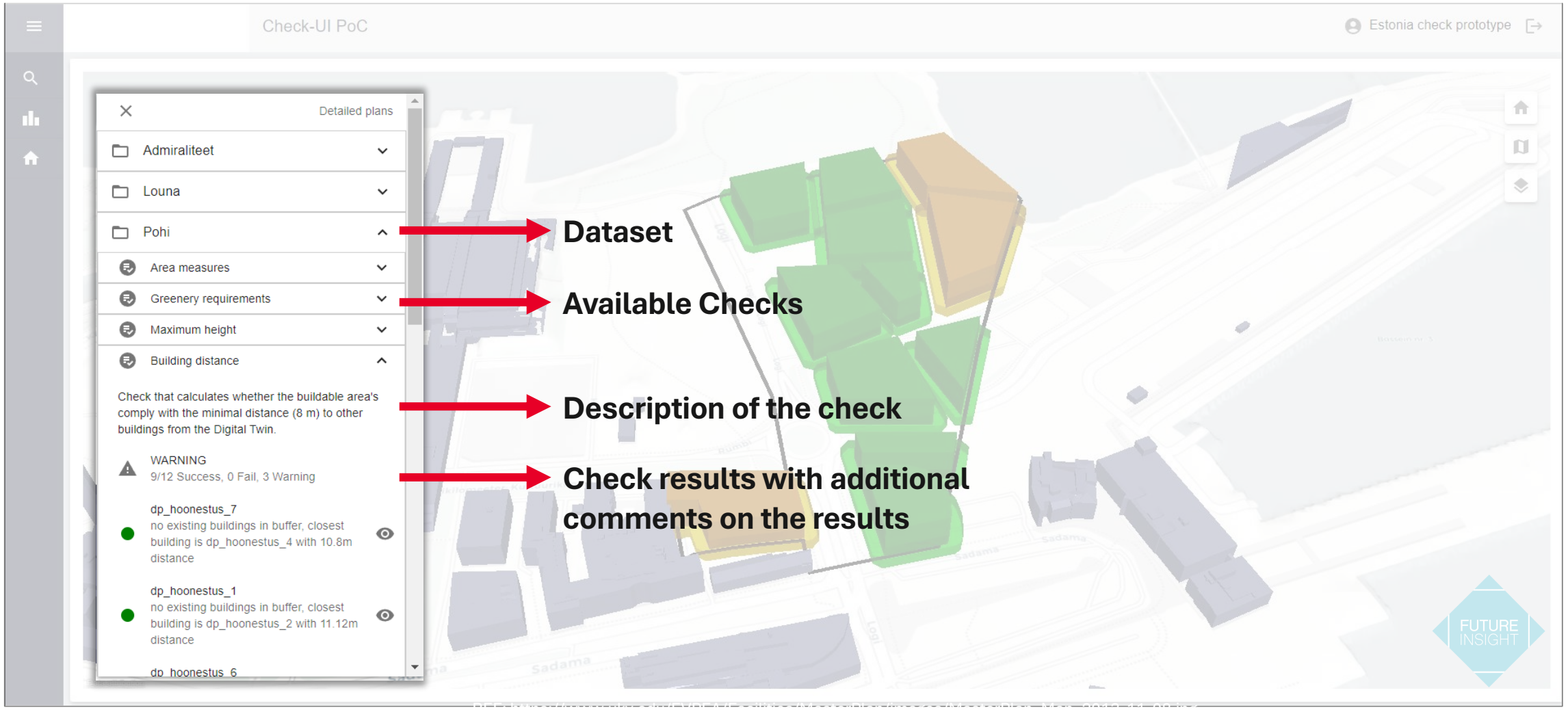
4. Implementation

Compliance Checks: *Example*



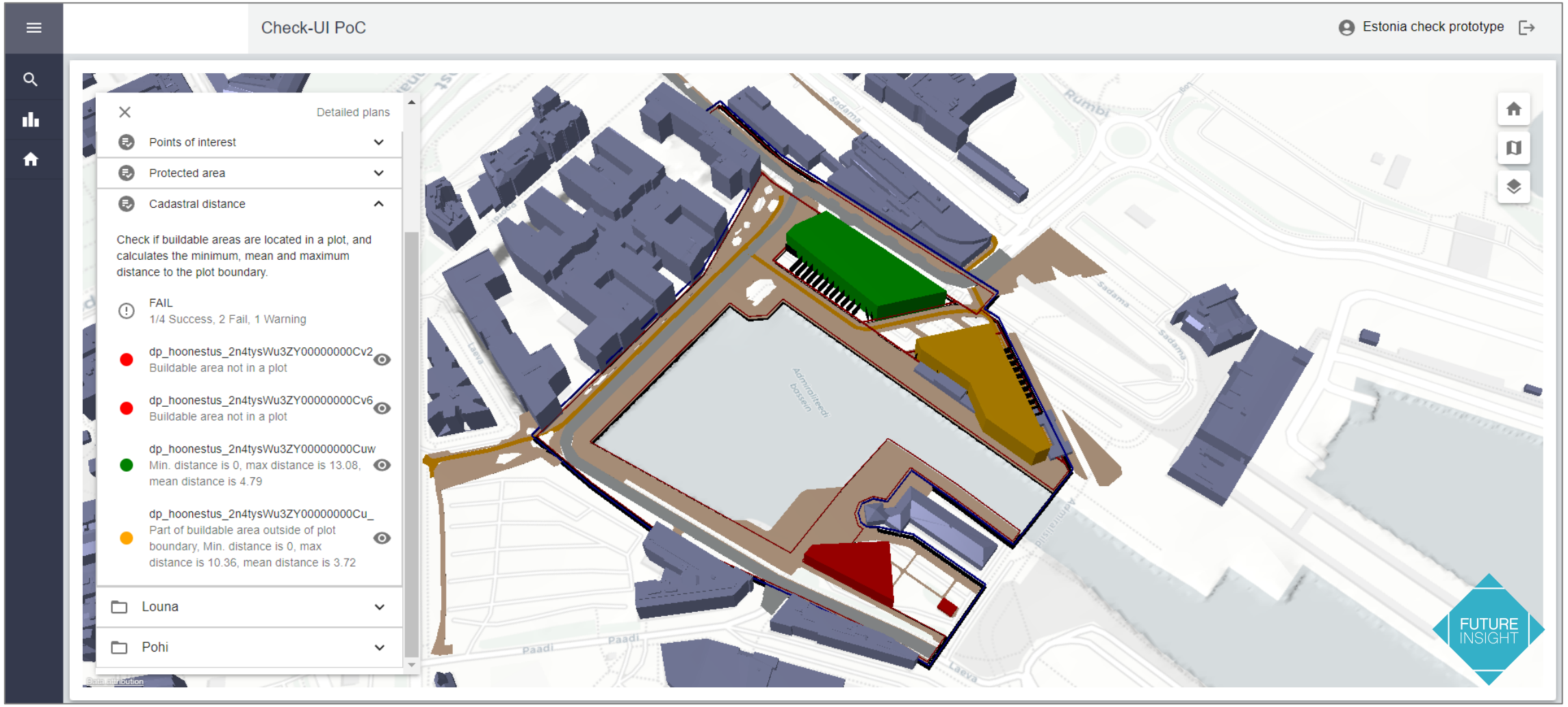
4. Implementation

Compliance Checks: *Example*



4. Implementation

Compliance Checks: *Example*



4. Implementation

Final Pipeline

1

All plan types
(Master, Detailed plan etc.)

IFC CityGML

2

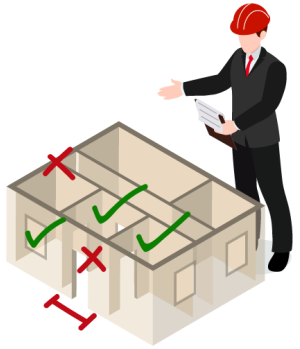
Access required information

3

Store information through LADM

4

Compute checks



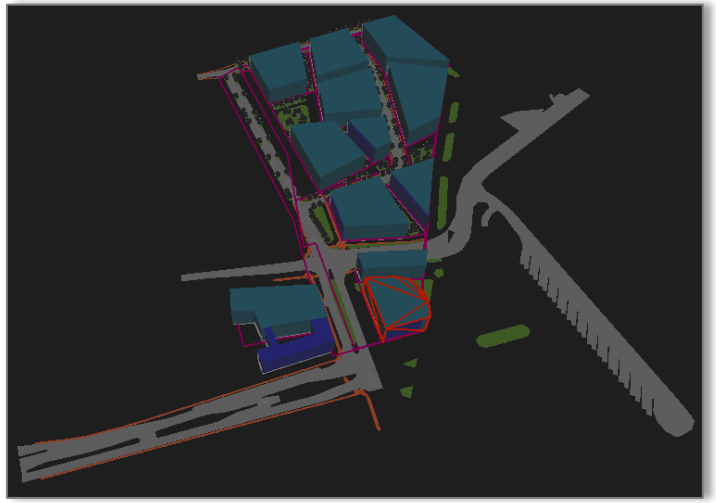
5

Check results

4. Implementation

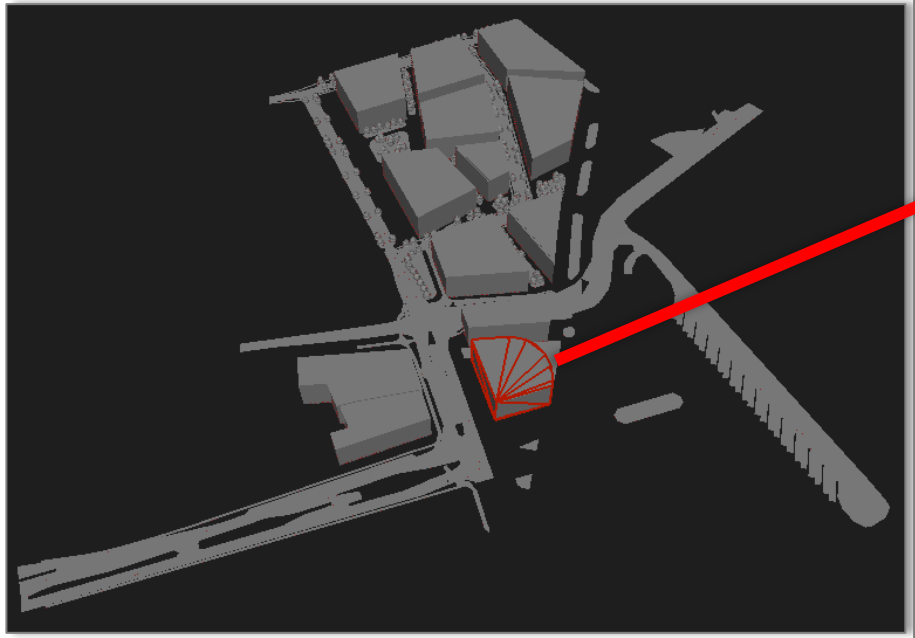
Data Read from the Database

Initial data



Information stored in the DB

Data read from the LADM database



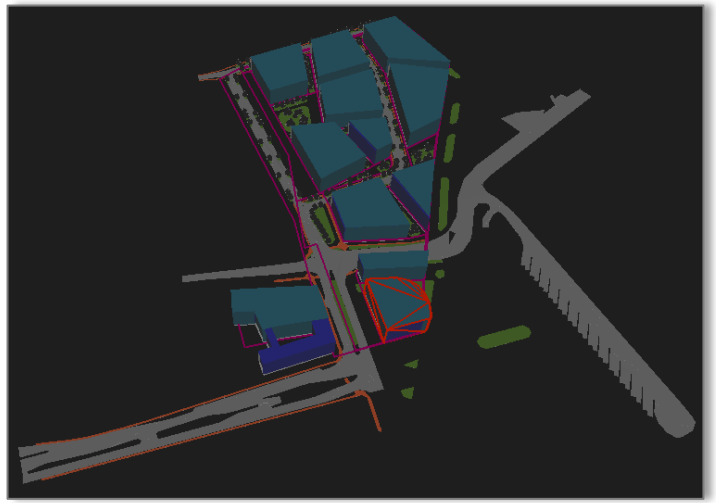
Features Selected: 1 of 1 In: public.est_detailed_unit

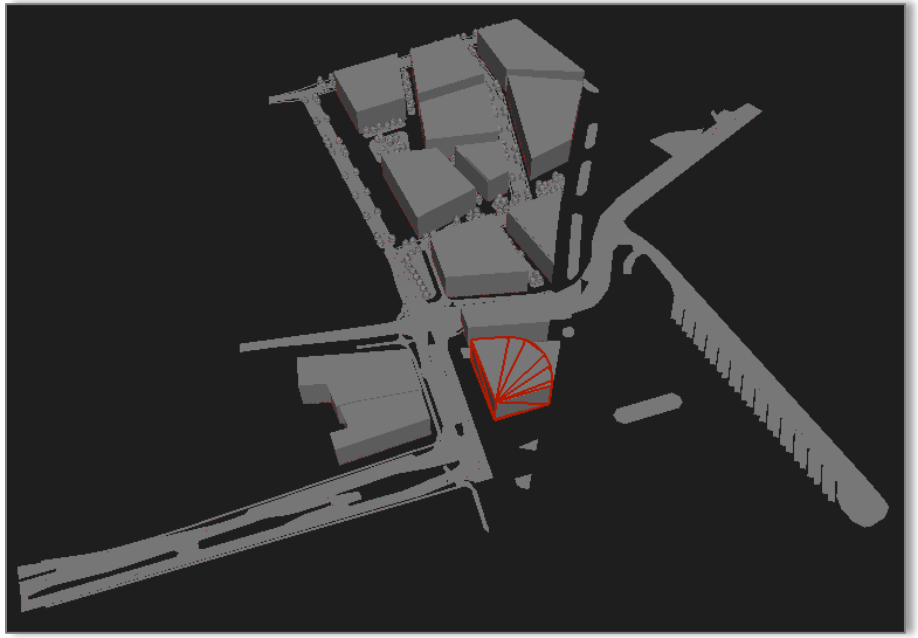
Property	Value
sub_function_n...	<null>
sub_function_ty...	<null>
surface_relation	3
type_of_buildin...	<null>
type_of_shape_i...	<null>
unit_indications	<null>
begin_lifespan_...	20240929
begin_real_worl...	<null>
end_lifespan_ve...	<null>
begin_lifespan_l...	20240929
initiated_date	2019
current_area	1824
current_volume	43777
discipline	dp_hoonestus
global_id	2n4tysWu3ZY00000000CtN
Unexposed...	
postgis_type	postgis_polyhedralsurface
FME Attribute...	
Geometry	
Coordinate ...	EPSG:3301
Dimension	3D

Filter in Any

4. Implementation

Data Read from the Database





PostGIS (PostgreSQL) **Technical Constraint**

- PostGIS **CANNOT store** geometry **appearance/style** (e.g., color).
- No solution was found during the research, but **future optimizations could explore alternatives of PostGIS.**
  - **E.g.,** using MongoDB with GeoJSON for styled geometries

    OR
  - developing custom scripts to manage styles separately from geometry.

4. Implementation

Scenarios where LADM can be used for Checks

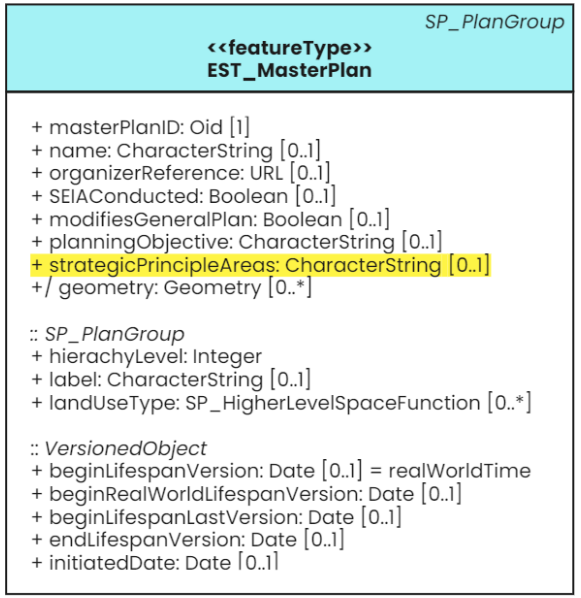
One of the **benefits** of utilizing LADM for the compliance checking pipeline is that **some of the checks can be executed directly in the database**.

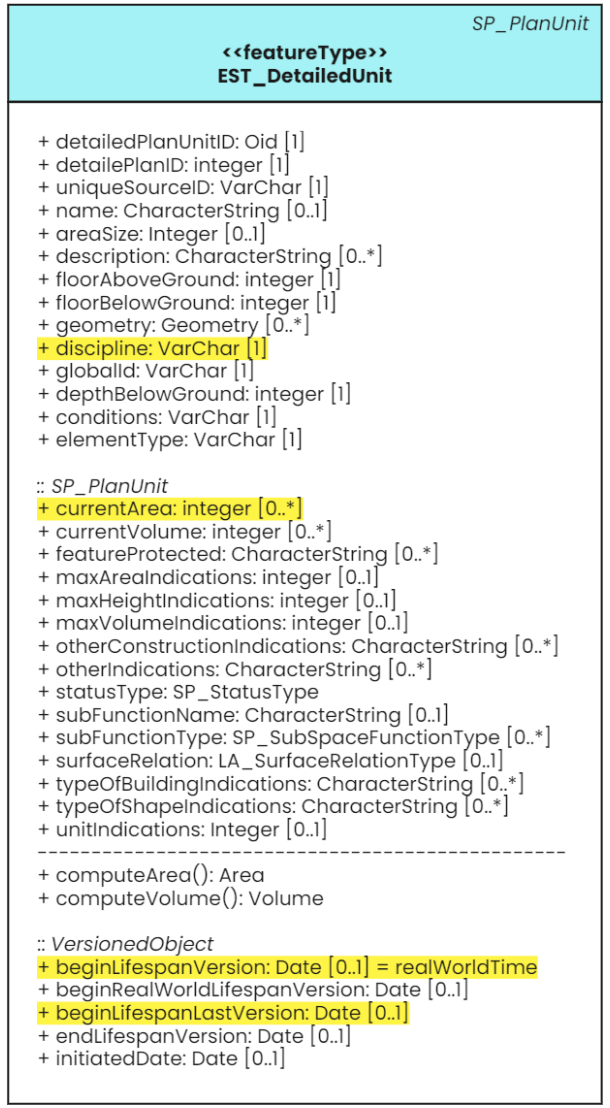
4. Implementation

Scenarios where LADM can be used for Checks

CHECK: *Compare the two most recent versions of the Detailed Plan "Central Park" to assess whether they meet the Master Plan's greenery requirement of at least 30% of the total plan area.*

Classes from LADM used for this check





4. Implementation

Scenarios where LADM can be used for Checks

CHECK: *Compare the two most recent versions of the Detailed Plan "Central Park" to assess whether they meet the Master Plan's greenery requirement of at least 30% of the total plan area.*

Example SQL query in the database

```sql
WITH latest_versions AS (
    SELECT
        dp.detailed_plan_id,
        dp.name AS plan_name,
        dp.begin_lifespan_version,
        dp.end_lifespan_version,
        dp.master_plan_id,
        ROW_NUMBER() OVER (
            PARTITION BY dp.detailed_plan_id
            ORDER BY dp.begin_lifespan_version DESC
        ) AS version_order
    FROM
        est_detailed_plan dp
    WHERE
        dp.detailed_plan_id = '101'  -- Example plan ID for comparison
        AND dp.begin_lifespan_version = dp.begin_lifespan_lastversion -- Identifies the most recent version
)
SELECT
    lv.detailed_plan_id AS detailedPlanID,
    lv.plan_name,
    lv.begin_lifespan_version AS plan_start_date,
    lv.end_lifespan_version AS plan_end_date,
    SUM(CASE WHEN du.discipline = 'dp_haljastus' THEN du.current_area ELSE 0 END) AS greenery_area,
    SUM(CASE WHEN du.discipline = 'plan_ala' THEN du.current_area ELSE 0 END) AS plot_area,
    ROUND(
        SUM(CASE WHEN du.discipline = 'dp_haljastus' THEN du.current_area ELSE 0 END) /
        SUM(CASE WHEN du.discipline = 'plan_ala' THEN du.current_area ELSE 0 END) * 100, 2
    ) AS greenery_percentage,
    mp.strategic_principle_areas AS master_plan_requirement
FROM
    latest_versions lv
JOIN
    est_detailed_unit du ON lv.detailed_plan_id = du.detailed_plan_id
JOIN
    est_master_plan mp ON lv.master_plan_id = mp.master_plan_id
WHERE
    lv.version_order <= 2  -- Select the last two versions based on lifespan versioning
    AND mp.strategic_principle_areas ILIKE '%min 30% greenery for an area of 5000 square meters%'
GROUP BY
    lv.detailed_plan_id, lv.plan_name, lv.begin_lifespan_version,
    lv.end_lifespan_version, mp.strategic_principle_areas;
```

4. Implementation

Scenarios where LADM can be used for Checks

CHECK: *Compare the two most recent versions of the Detailed Plan "Central Park" to assess whether they meet the Master Plan's greenery requirement of at least 30% of the total plan area.*

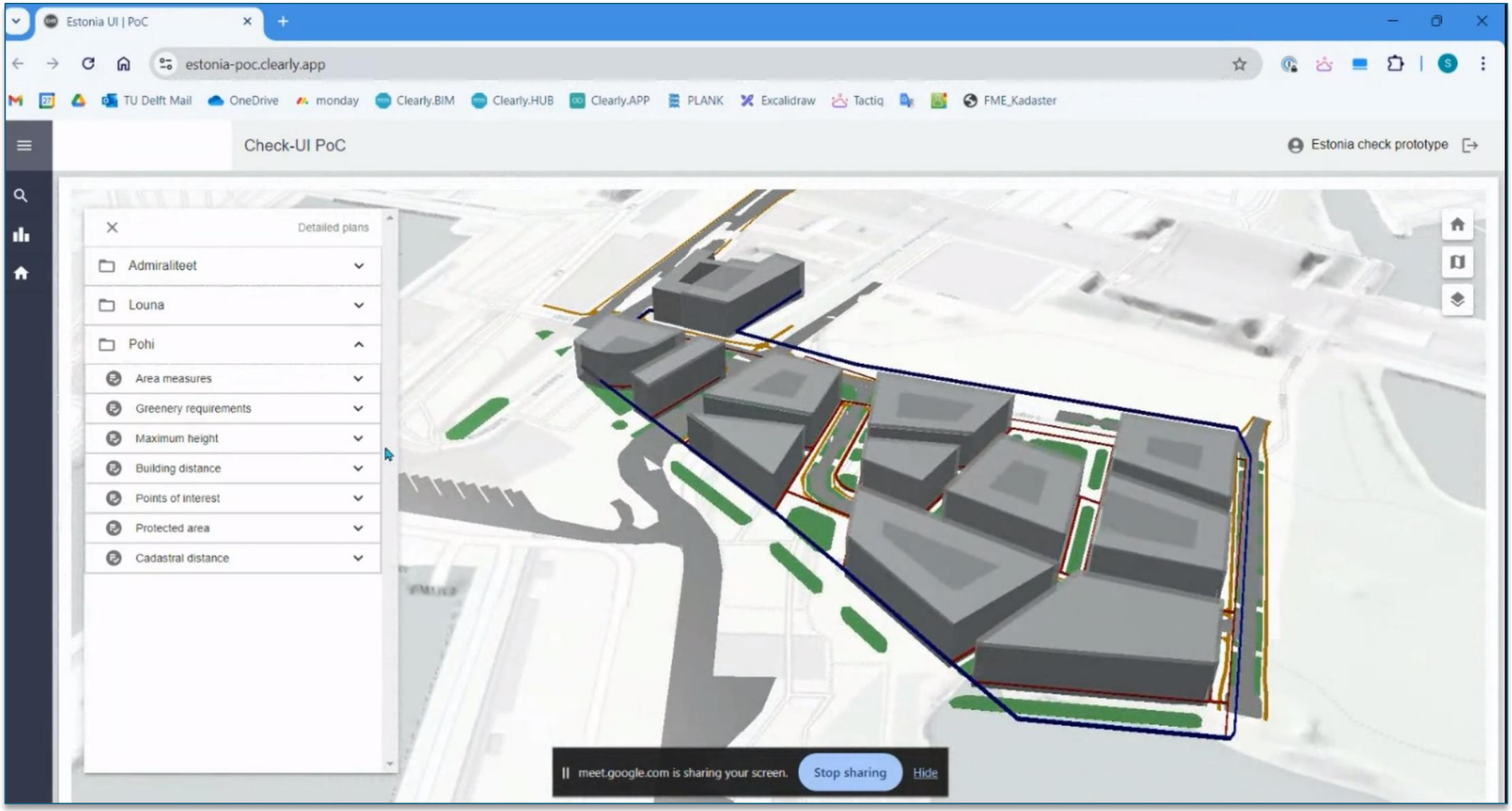
Example output of the query

Detailed Plan ID	Plan Name	Plan Start Date	Plan End Date	Greenery Area	Plot Area	Greenery Percentage	Master Plan Requirement
101	Central Park	2024-01-01	2024-03-31	1500	5000	30.00	*min 30% greenery for an area of 5000 square meters*
101	Central Park	2024-04-01	2024-06-30	1400	5000	28.00	*min 30% greenery for an area of 5000 square meter*

The results show that the first version of the Detailed Plan meets the Master Plan's minimum 30% greenery requirement, while the second version falls short, with only 28% greenery, failing the compliance check.

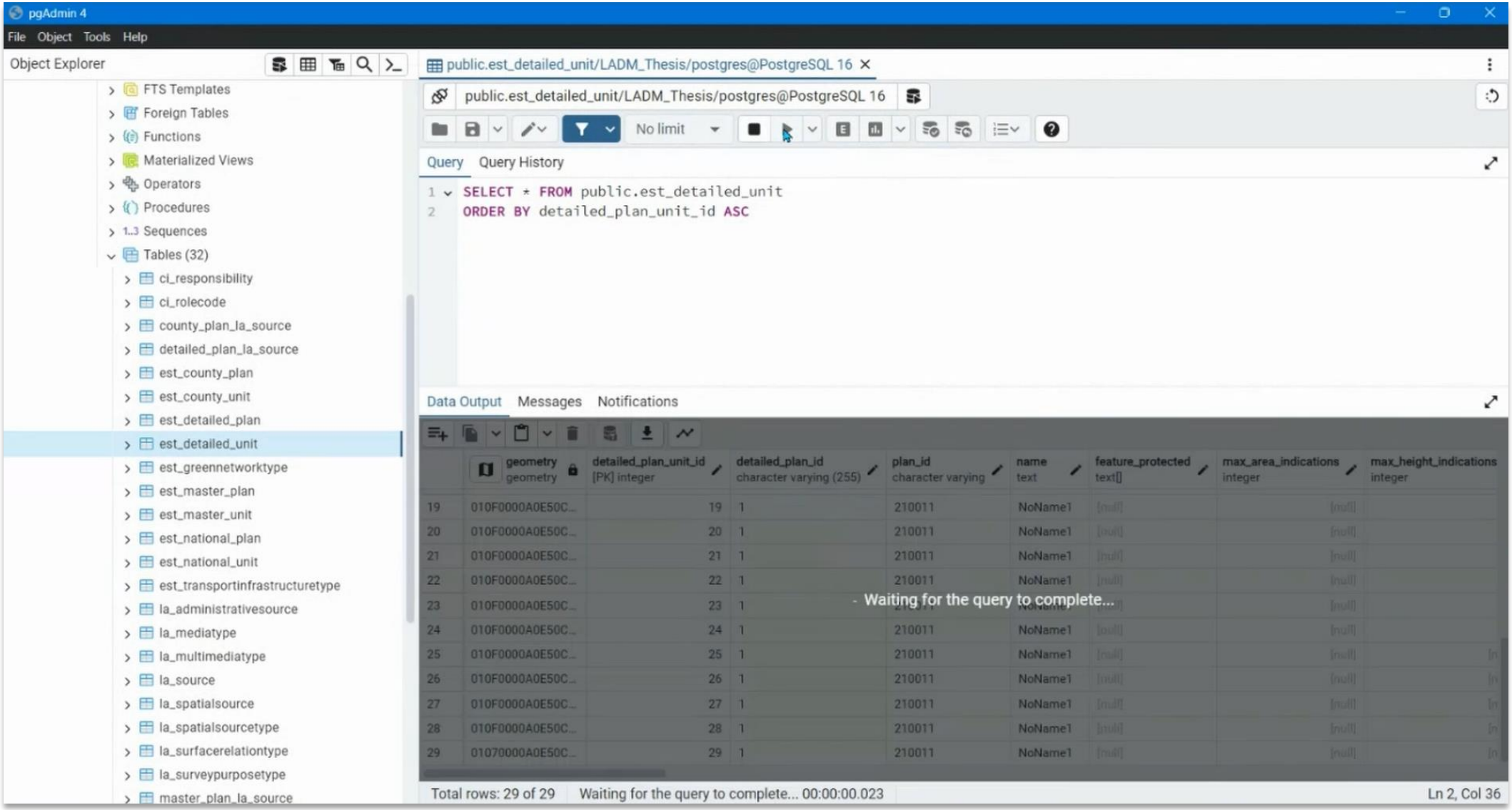
5. Video Example (1 min)

Uploading the plans to the database

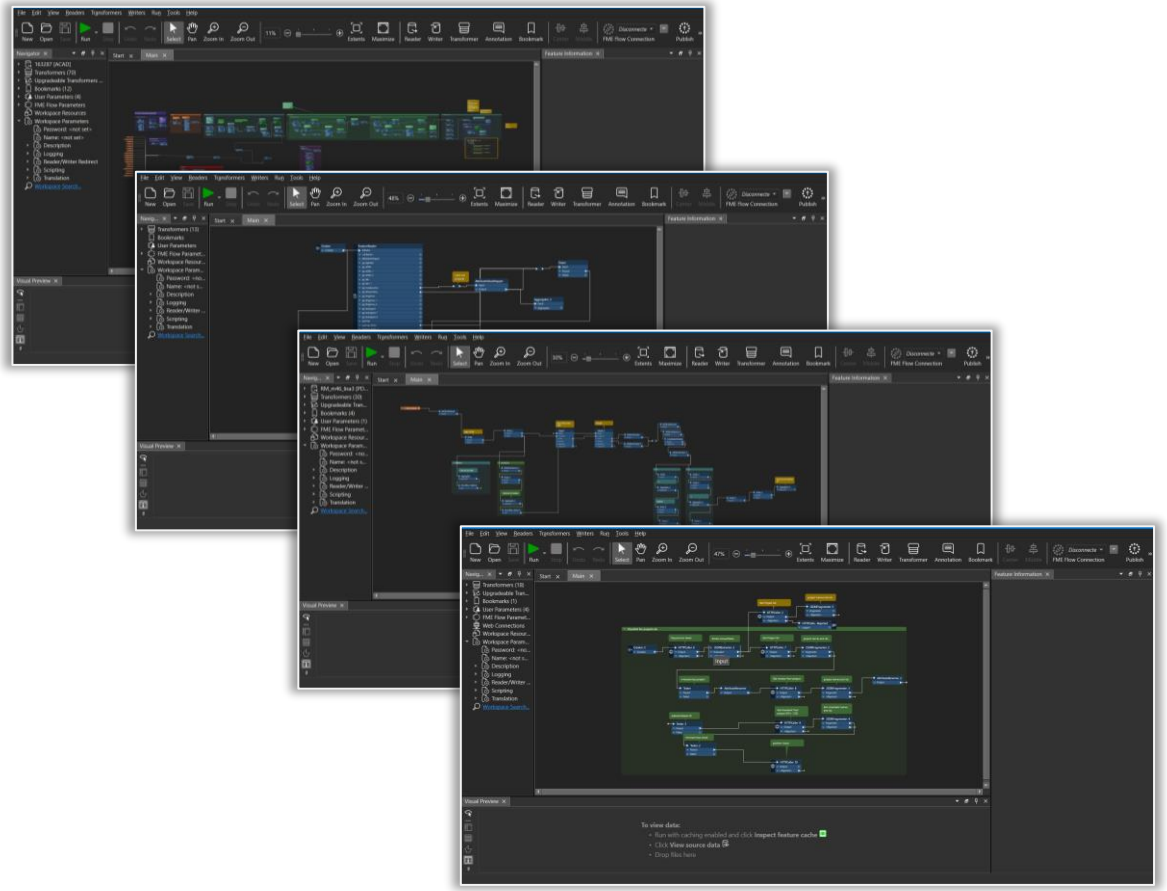


5. Video Example (>1 min)

Reading the plans from the database

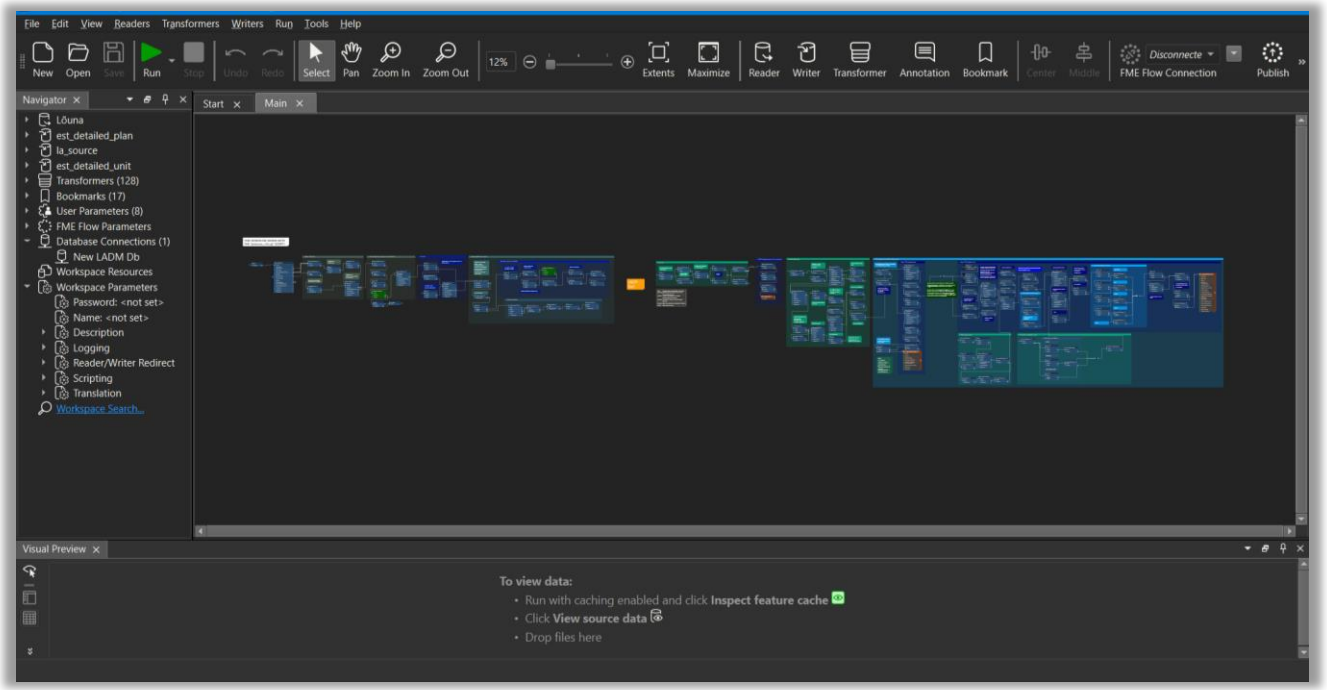


5. Conclusion and Future Research



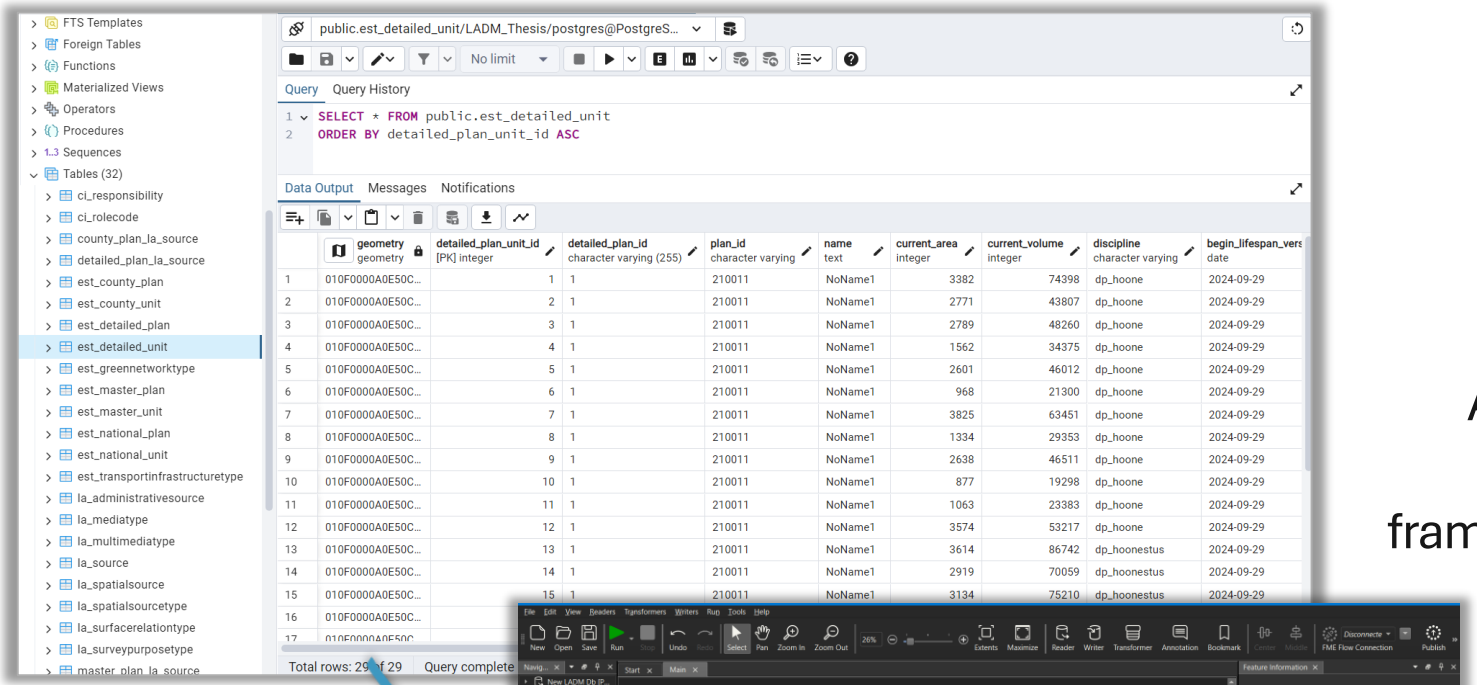
Instead of using **many cumbersome scripts** to extract and validate the necessary plan information and metadata every time…

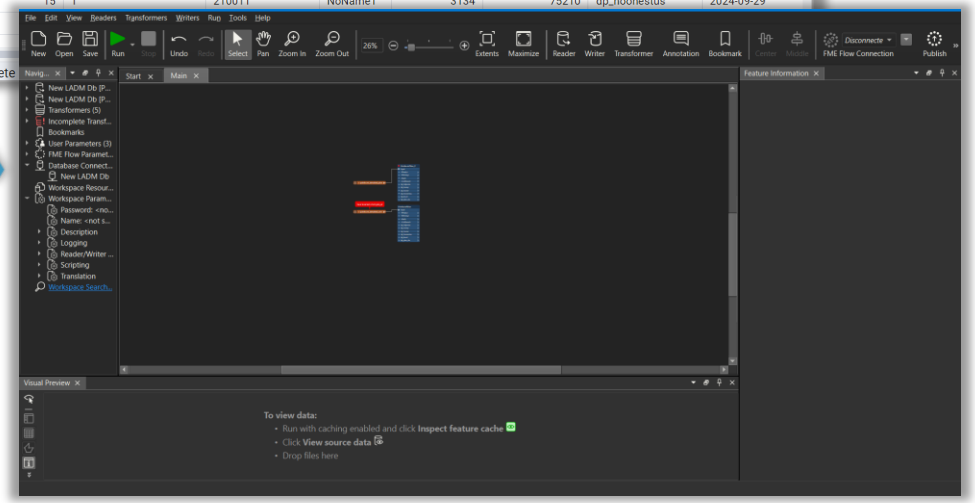
5. Conclusion and Future Research



We upload the plan data and metadata to the LADM database ***one time…***

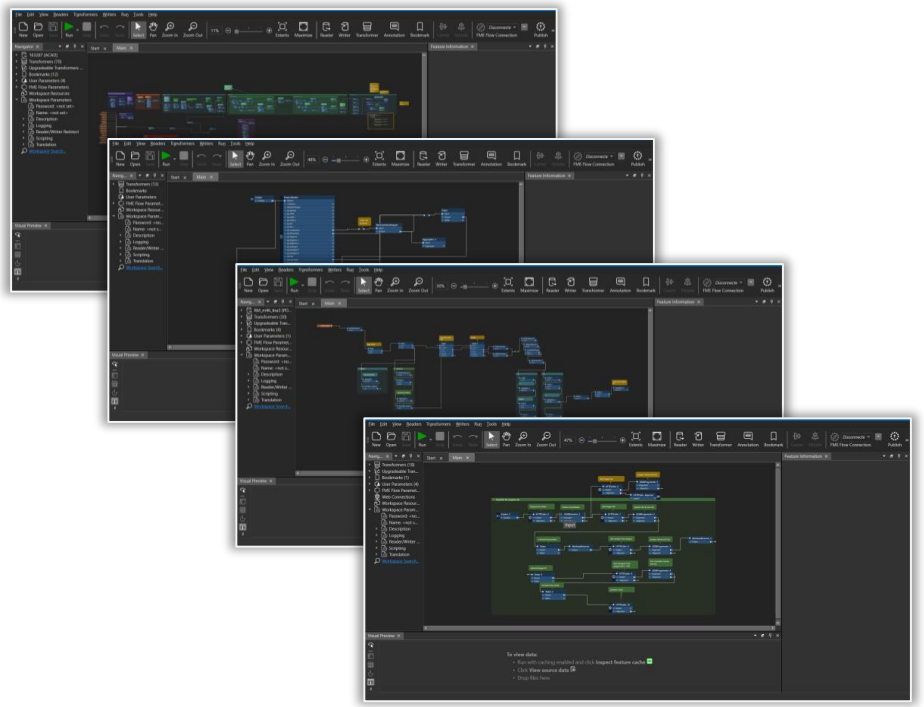
5. Conclusion and Future Research

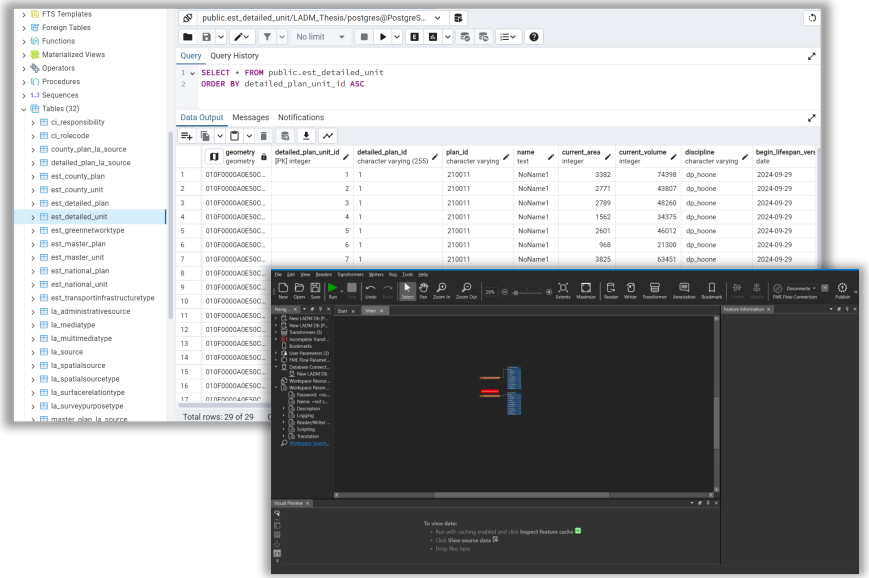




And **directly read** the necessary information from the structured framework of the **LADM database** after.

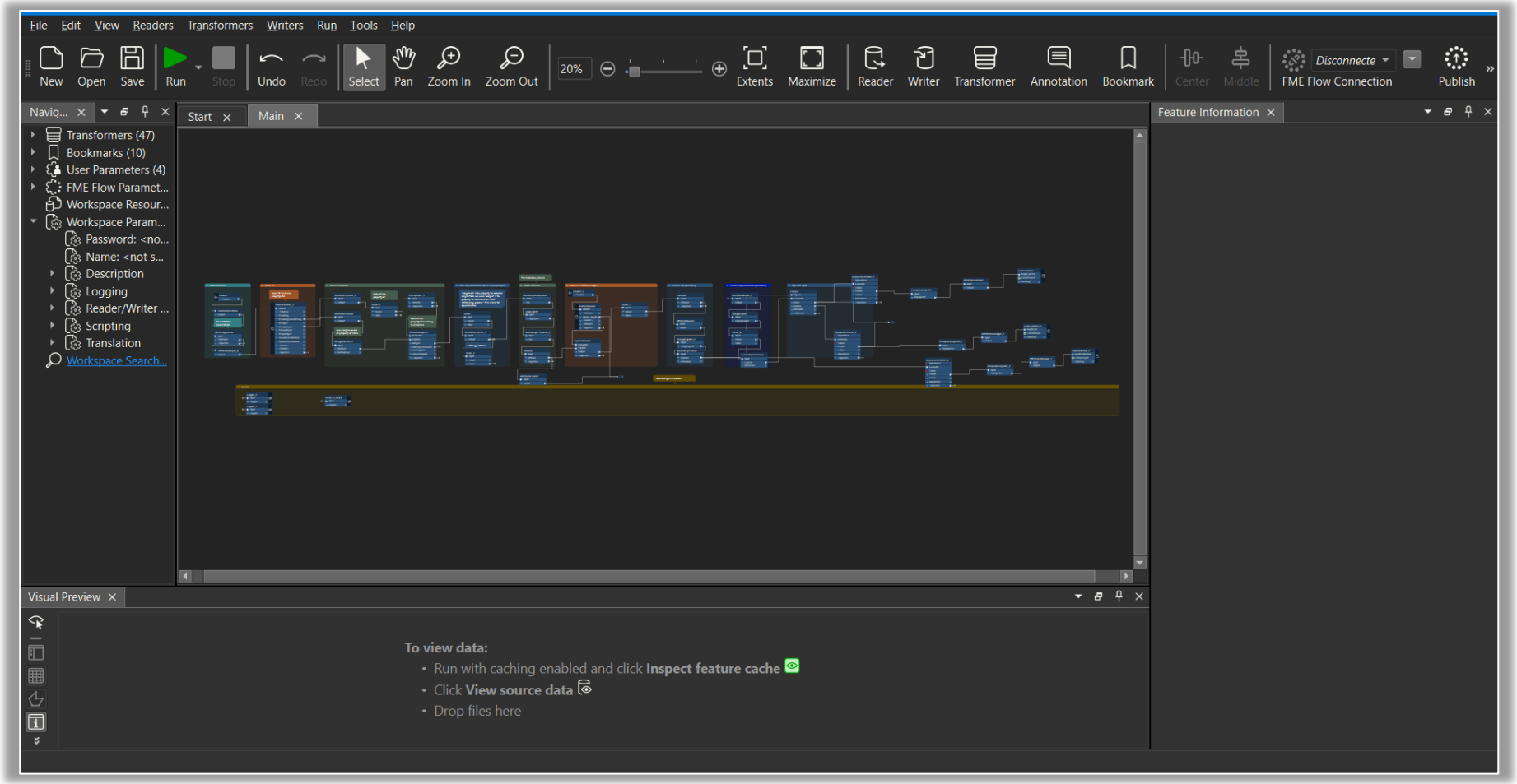
5. Conclusion and Future Research





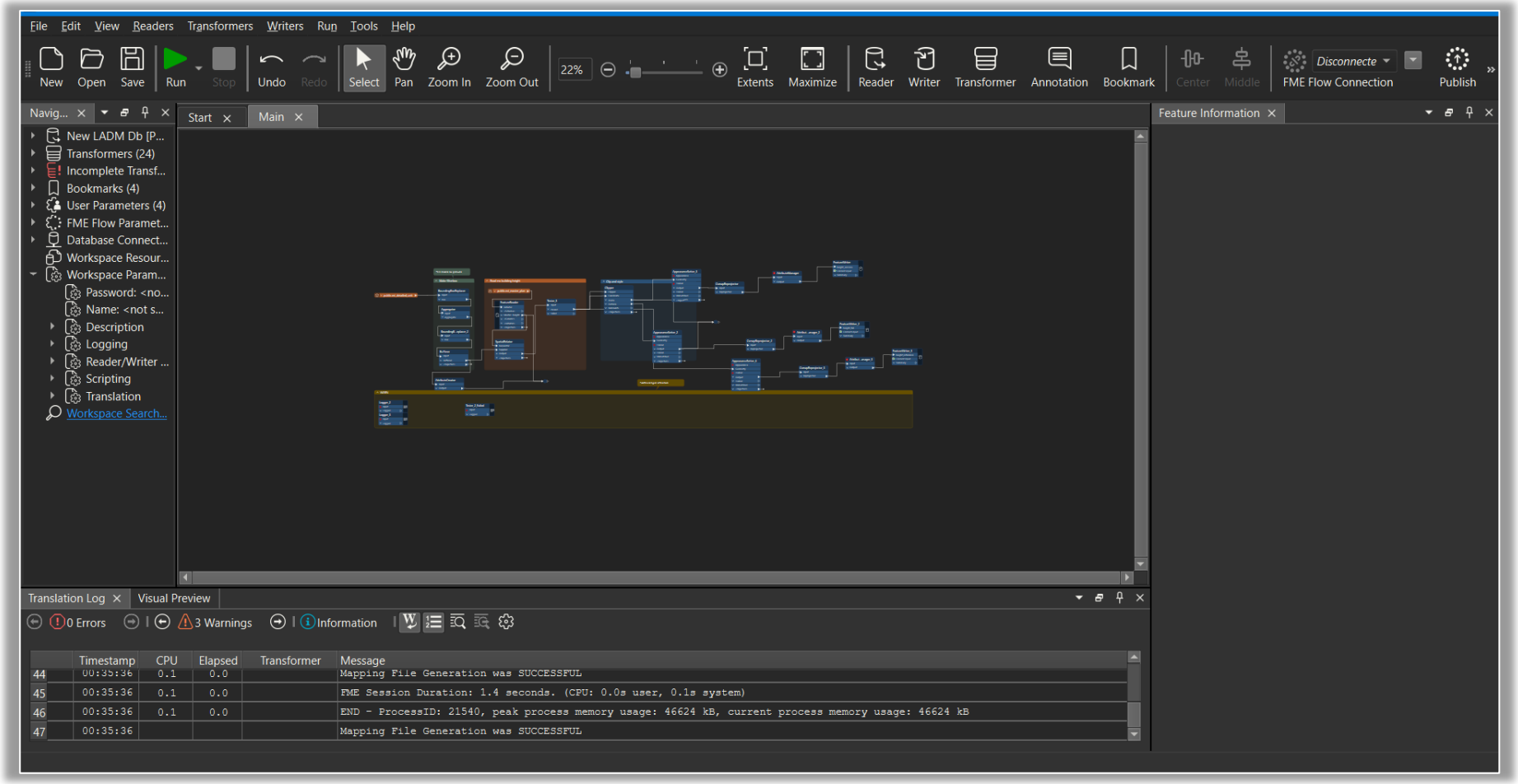
5. Conclusion and Future Research

Current FME script used for the "building height" check:



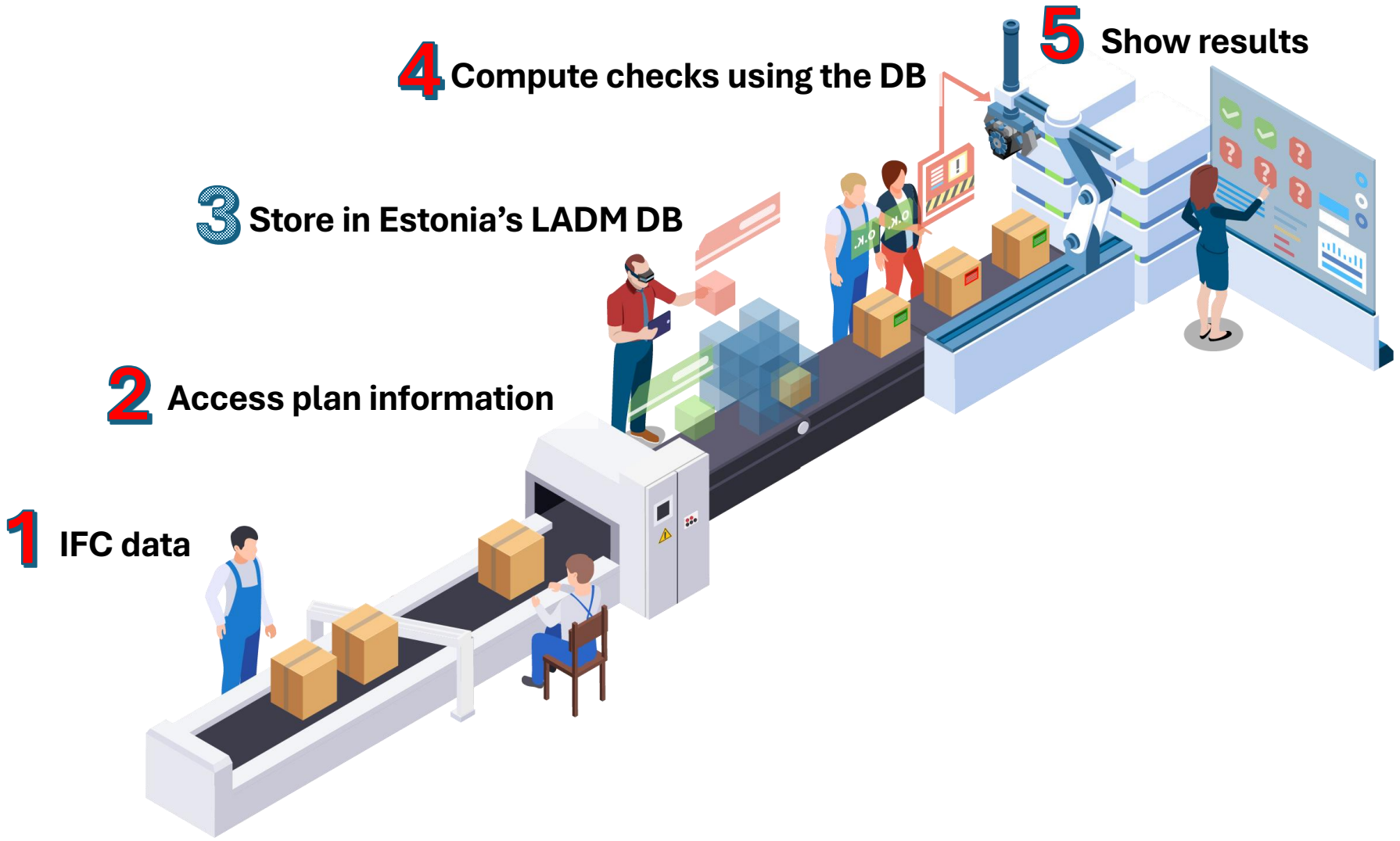
5. Conclusion and Future Research

If LADM database was used for input plan data for the "building height" check:



5. Conclusion and Future Research

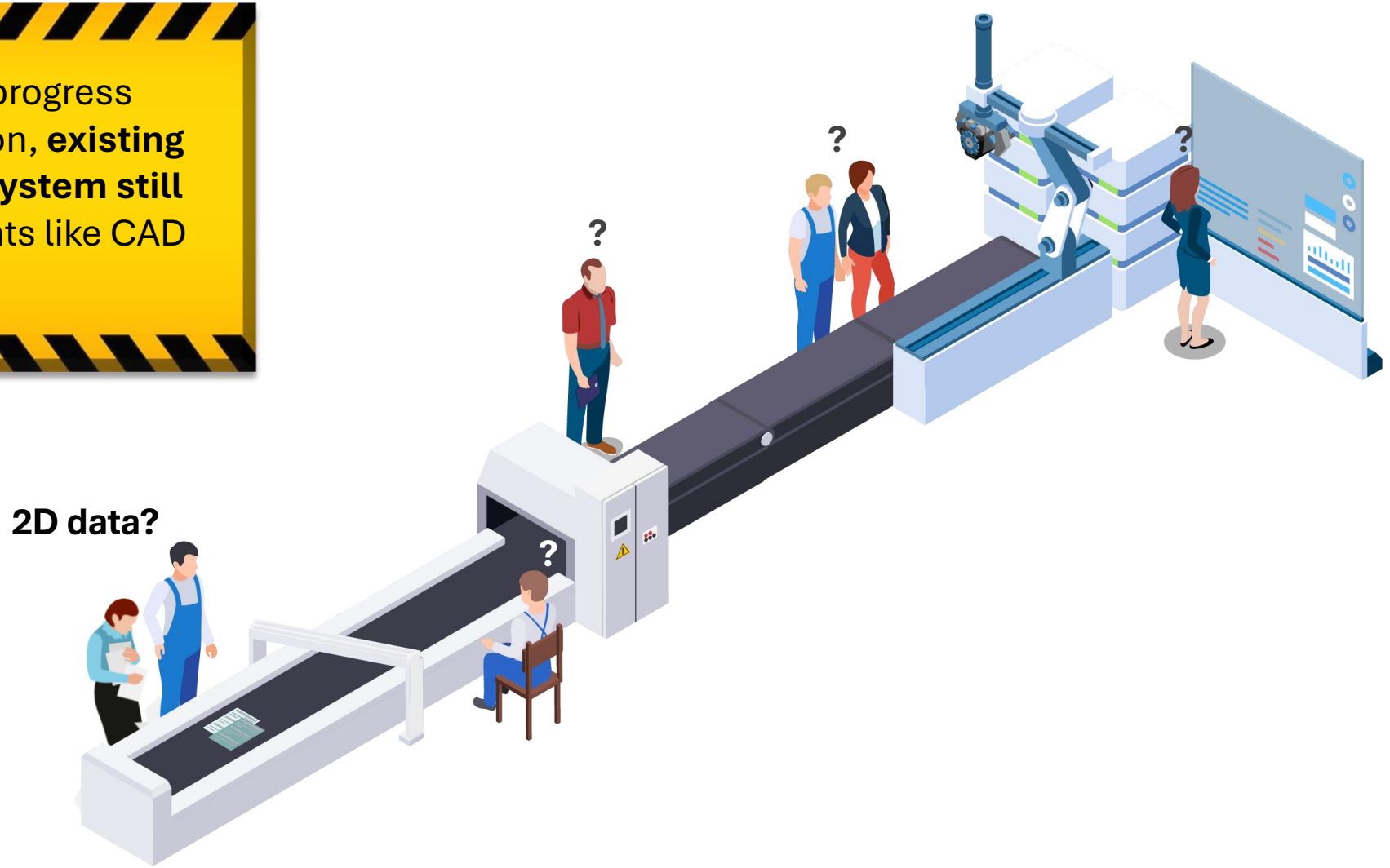
Final Pipeline



5. Conclusion and Future Research

Investigation of existing 2D data

Despite Estonia's progress toward digitalization, **existing spatial planning system still relies on 2D** formats like CAD and PDFs.

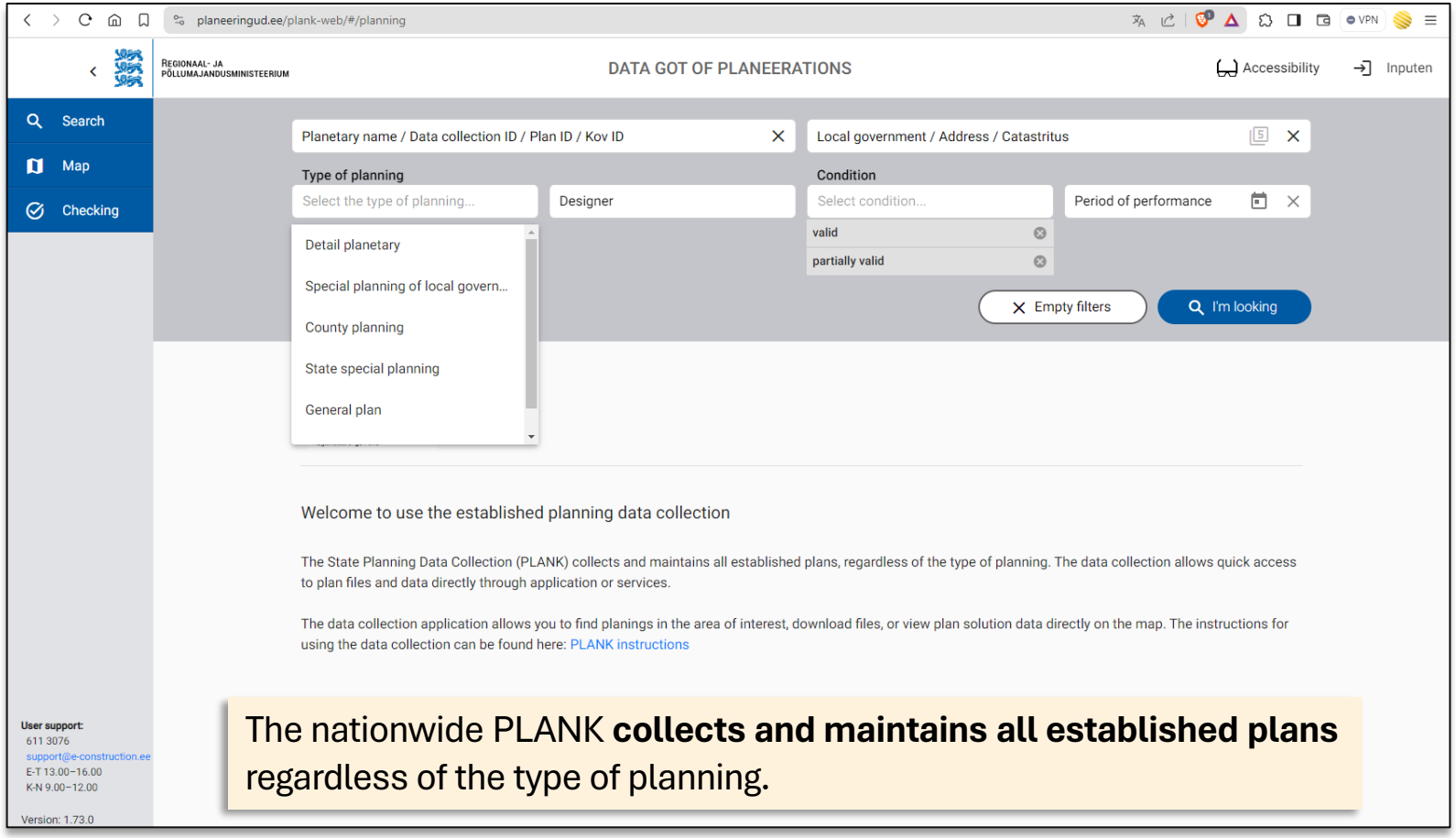


5. Conclusion and Future Research

Investigation of existing 2D data

A **real-world Detailed Plan example** from PLANK was investigated.

Planetary Data Collection *(PLANK)* platform

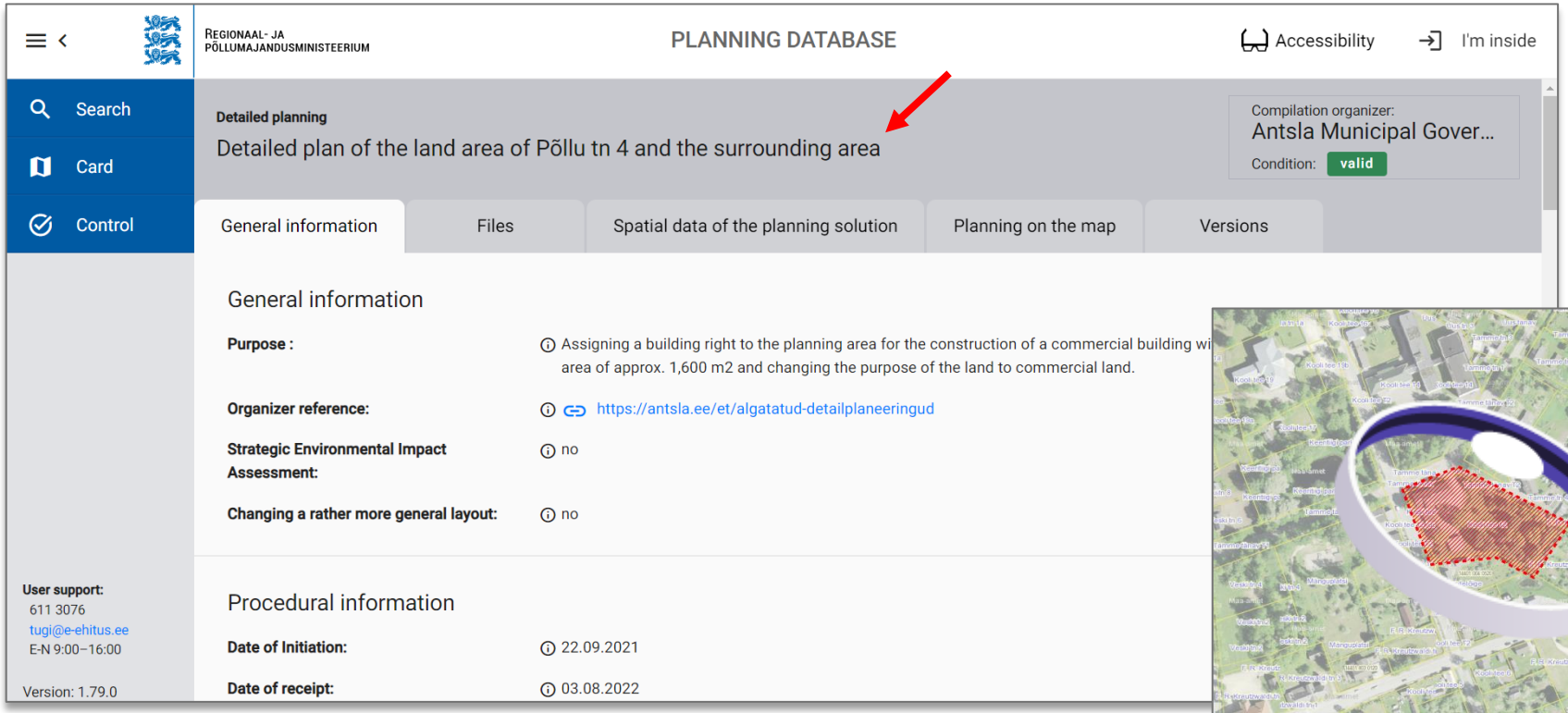


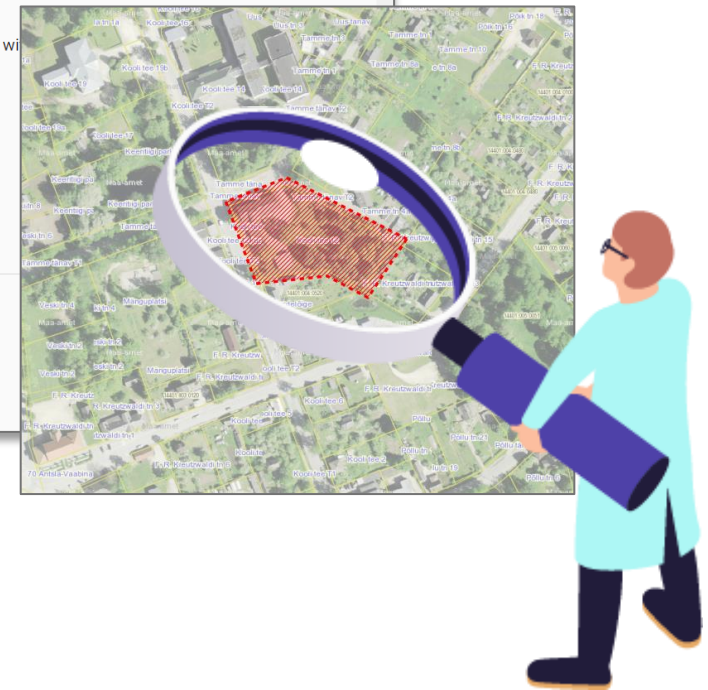
The nationwide PLANK **collects and maintains all established plans** regardless of the type of planning.

5. Conclusion and Future Research

Investigation of existing 2D data

Detailed plan of "*Põllu tn 4 and the surrounding area*"





Main aim: Change the land use from residential to commercial and allow two commercial buildings.

5. Conclusion and Future Research

Investigation of existing 2D data

Available plan files on PLANK database.

Explanation letter (1)

SK100 Explanation letter — Põllu_tn_4_DP Explanation letter_09-09-2022.pdf

Representations of drawings (2)

JN100 Basic drawing, complete solution, land use plan — Põllu_tn_4_DP_4_Main drawing_22-07-2022.pdf

JN220 Technical networks, technical networks — Põllu_tn_4_DP_5_Technovõrgud_06-07-2022.pdf

Digital Layers (3)

DK402 Metadata table — Põllu-tn-4_DP_metaandmed_18.10.2022.xlsx

DK401 Smart data table — Põllu tn 4_DP_star data_table_19.10.2022.xlsx

DK202 Planning solution containing spatial data (dwg) — Põllu_tn_4_DP_digital_layers_19.10.2022.dwg

Legal basis (1)

HO101 Enforcement decision — Establishment of detailed planning_Field 4.asice

Digitally signed plan (1)

DD100 Digitally signed plan — Põllu_tn_4_DP_09-09-2022.asice

Extras (6)

UU603 Contact zone analysis — Põllu_tn_4_DP_3_Kontaktvönd_29-03-2022.pdf

ML105 Situation diagram — Põllu_tn_4_DP_1_Situation scheme_29-03-2022.pdf

UU602 Analysis of the existing situation — Põllu_tn_4_DP_2_Olemasoleb-ulokord_18-07-2022.pdf

RI100 Spatial illustrations — Põllu_tn_4_DP_6_Illustration_18-07-2022.pdf

MD101 Procedural Documents Folder — Põllu_tn_4_DP Additions.asice

ML109 Spatial data list of the planning solution — Field street 4_DP_jooniste_üldine_info.xlsx

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data

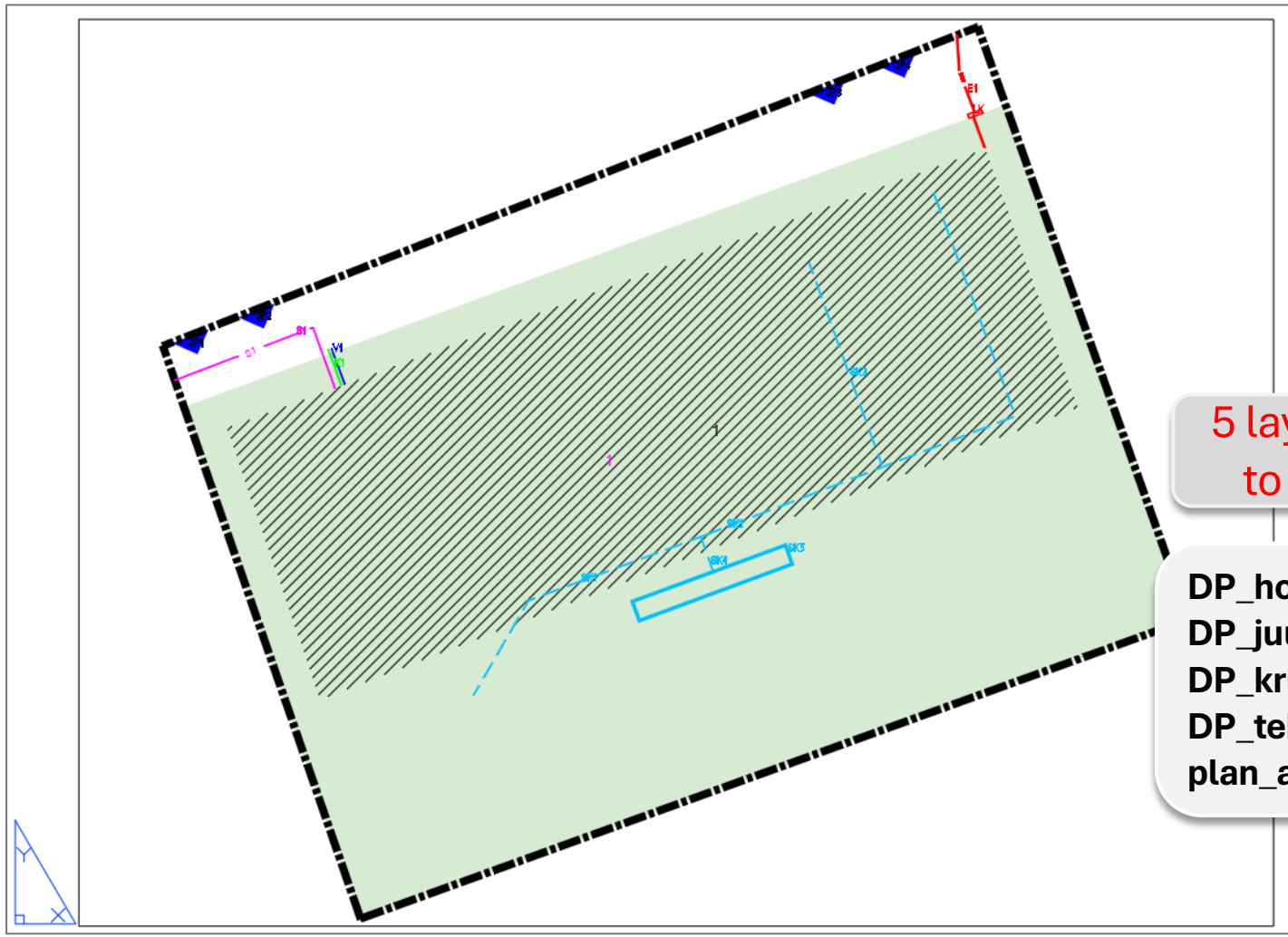
DK402 Metadata table

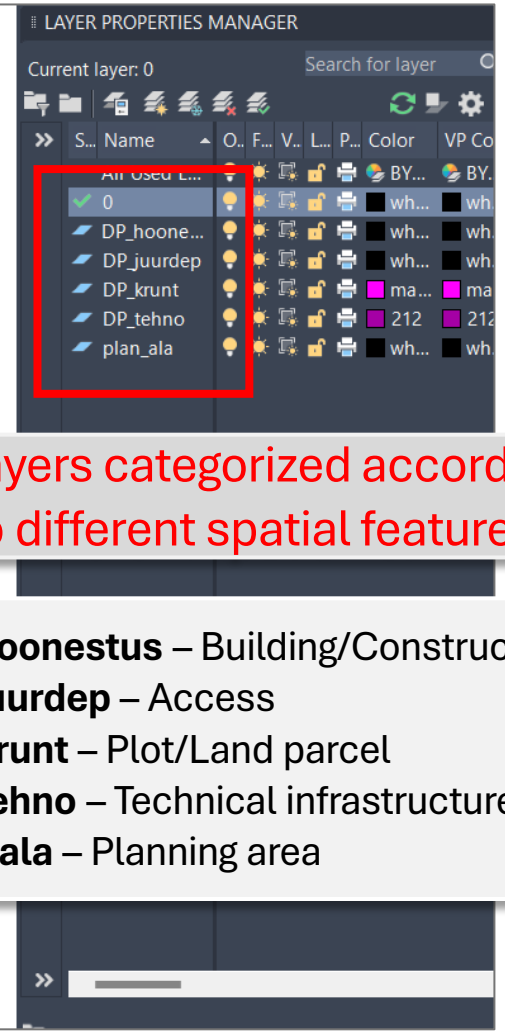
DK401 Smart data table

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data





5 layers categorized according to different spatial features

DP_hoonestus – Building/Construction
DP_juurdep – Access
DP_krunt – Plot/Land parcel
DP_tehno – Technical infrastructure
plan_ala – Planning area

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data

- The **metadata of the layers only relate to the visual aspects**

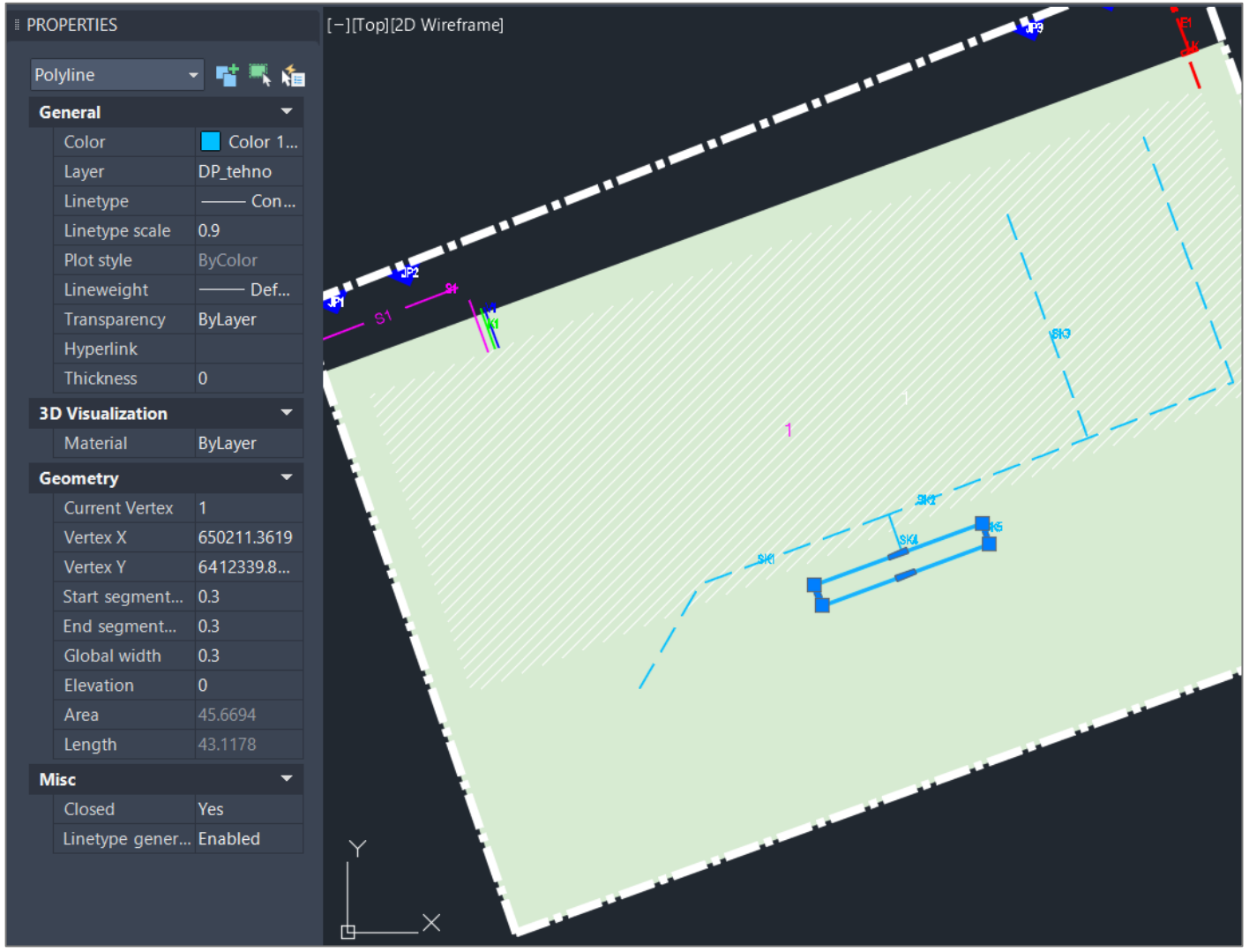
Property	Value
autocad_alignment_x	650207.3441505203
autocad_alignment_y	6412358.095696476
autocad_alignment_z	0
autocad_big_fontname	
autocad_color	6
autocad_entity	autocad_text
autocad_entity_handle	292
autocad_entity_visibility	visible
autocad_font_bold	No
autocad_font_charset	0
autocad_font_italic	No
autocad_font_pitch_family	34
autocad_font_typeface	Swis721 Lt BT
autocad_generation	autocad_normal
autocad_justification	autocad_baseline_left
autocad_layer	DP_krunt
autocad_layer_desc	
autocad_layer_frozen	no
autocad_layer_hidden	no
autocad_layer_locked	no
autocad_layer_on	yes
autocad_layer_plottable	yes
autocad_layer_type	not_frozen
autocad_linetype	ByLayer
autocad_linetype_scale	10
autocad_lineweight	-1
autocad_oblique	0
autocad_original_color	ByLayer
autocad_original_entity_type	autocad_multi_text
autocad_resolved_linetype	Continuous
autocad_resolved_lineweight	-3
autocad_resolved_transparency	-1
autocad_rotation	0
autocad_shape_filename	swissl.ttf

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data

- Thus, the DWG only provides the **geometric layout** and **basic visualization details**



5. Conclusion and Future Research

Investigation of existing 2D data

DK402 Metadata table

Planner | Preparer | Software Used | Model Scale | Coordinate System | Height System | Scale | Contact

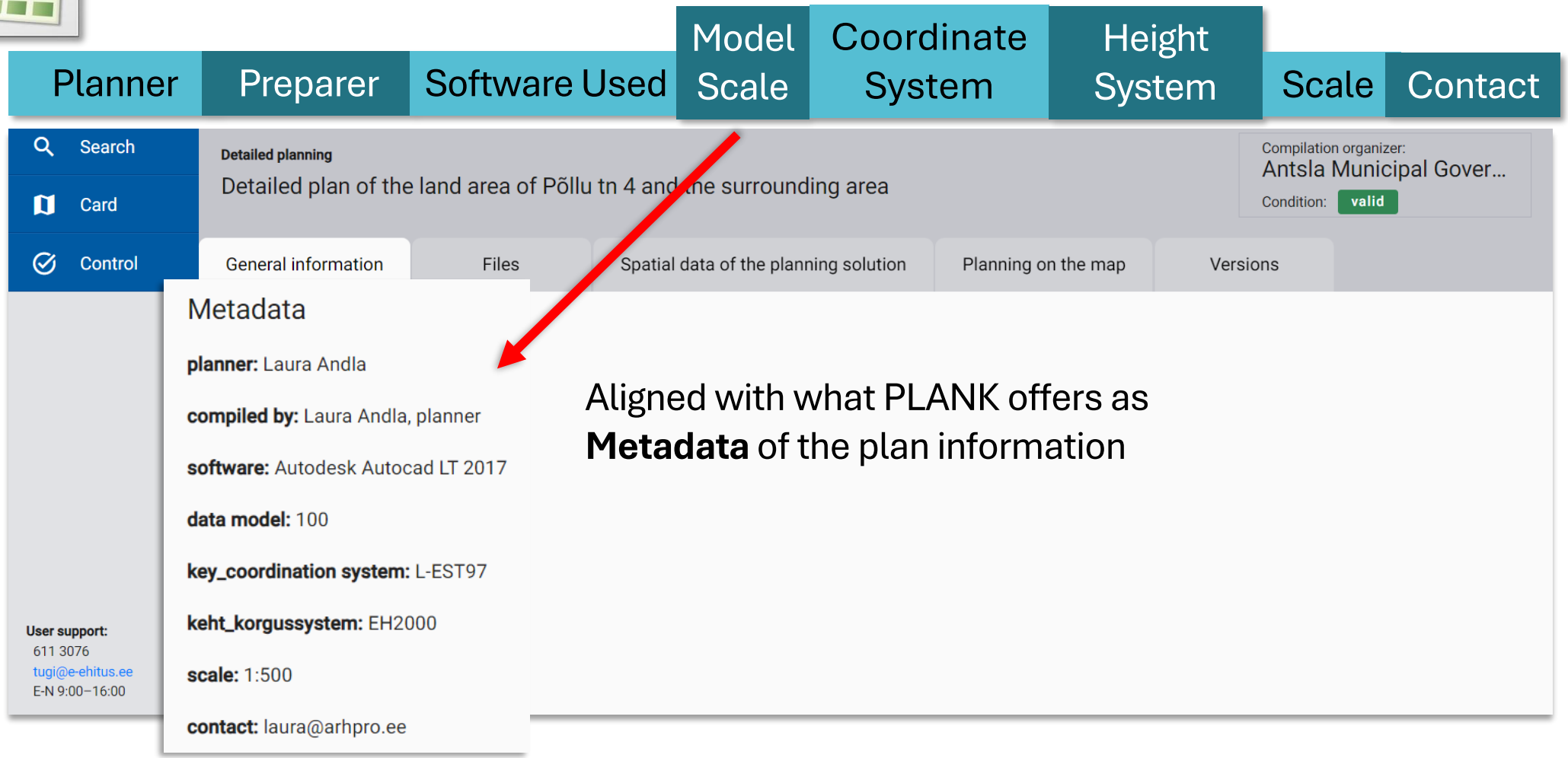
	A	B	C	D	E	F	G	H
1	**planeerija**	**koostaja**	**tarkvara**	**andmemudel**	**keht_koordinaatsysteem**	**keht_korgussysteem**	**mootkava**	**kontakt**
2	Laura Andla	Laura Andla, planeerija	Autodesk Autocad LT 2017	100	L-EST97	EH2000	1:500	laura@arhpro.ee
3								
4								

5. Conclusion and Future Research

Investigation of existing 2D data

DK402 Metadata table

Planner	Preparer	Software Used	Model Scale	Coordinate System	Height System	Scale	Contact



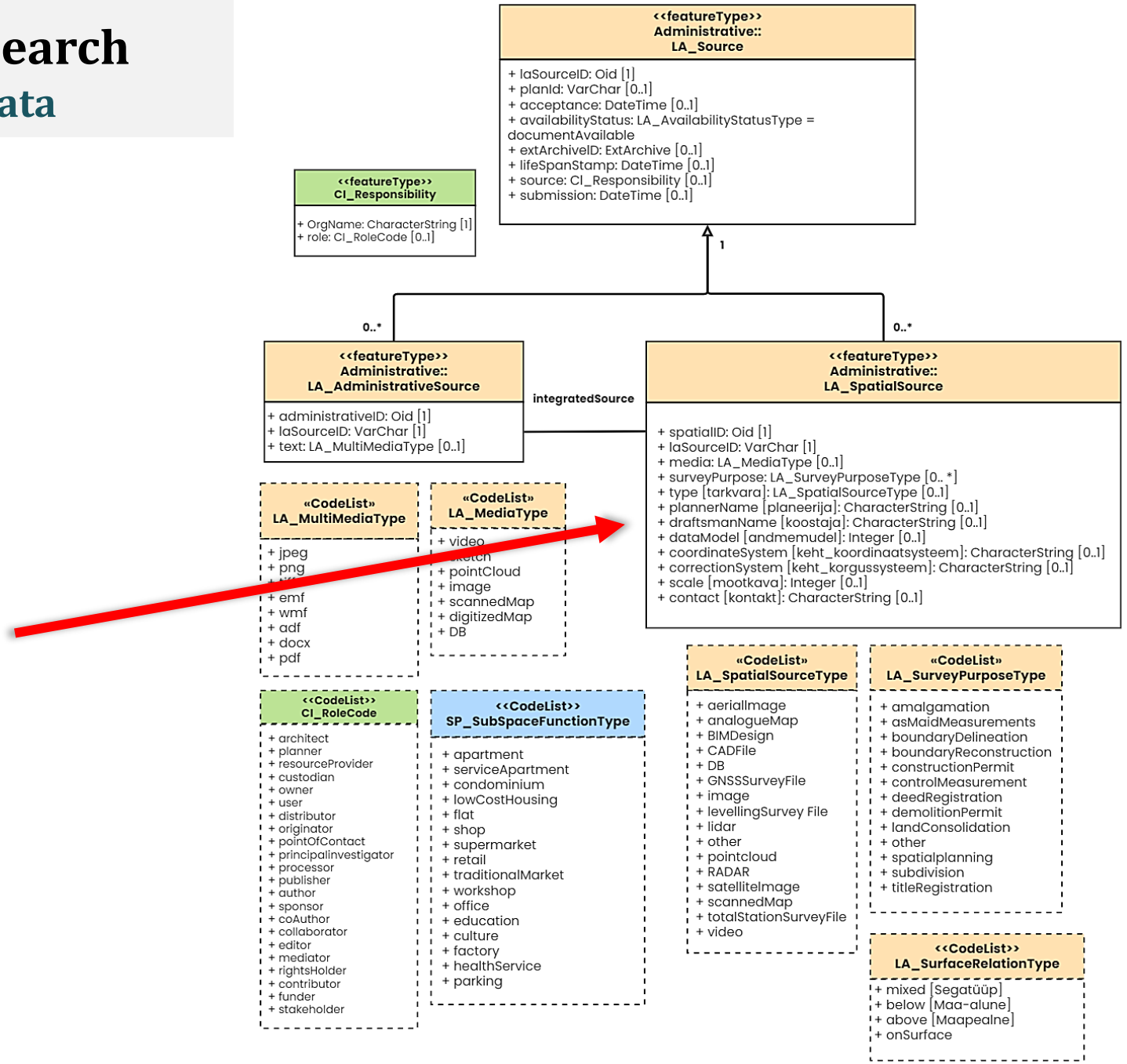
Aligned with what PLANK offers as **Metadata** of the plan information

5. Conclusion and Future Research

Investigation of existing 2D data

DK402 Metadata table

Estonia's **new LADM P5 profile also addresses** this information



5. Conclusion and Future Research

Investigation of existing 2D data

DK401 Smart data table

	A	B	C	D	E	F	G
1	**objectID**	**kruntOID**	**ehTyyp**	**arv**	**pind**	**korgus**	
2	1	1	10	2	1600	10	

plan_ala | DP_krunt | DP_krundisihtotstarve | DP_hoonestus | DP_juurdep | DP_tehno

	A	B	C	D	E	F
1	**objectID**	**nimetus**				
2	JP1	Teenindava transpordi juurdepääs krundile.				
3	JP2	Jalakäijate juurdepääs krundile.				
4	JP3	Jalakäijate juurdepääs krundile.				
5	JP4	Sõiduautode juurdepääs krundile.				

plan_ala | DP_krunt | DP_krundisihtotstarve | DP_hoonestus | DP_juurdep

	A	B	C	D	E	F	G	H	I	J
1	**planNim**	**planLiik**	**planKSH**	**planEesm**	**planViide**	**muutev**	**algatKp**	**vastuvKp**	**kehtestKp**	**kehtestNr**
2	Põllu tn 4 maa-ala	30	ei	Planeeringualale ehitusõiguse	https://antsla.ee/et/algatatud-	ei	22/09/2021	03/08/2022	21/09/2022	2-3/347
3										

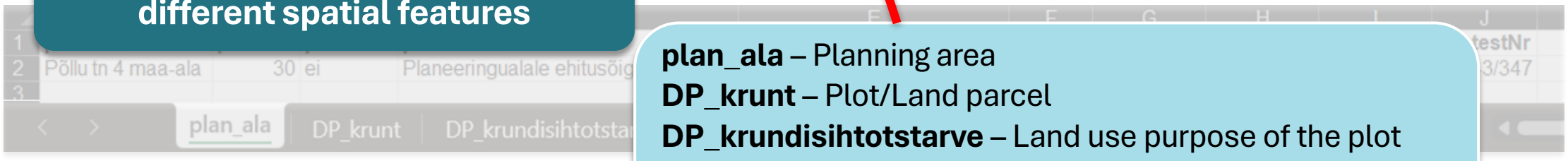
plan_ala | DP_krunt | DP_krundisihtotstarve | DP_hoonestus | DP_juurdep | DP_tehno

5. Conclusion and Future Research

Investigation of existing 2D data

DK401 Smart data table

***Layers* categorized according to different spatial features**



plan_ala – Planning area
DP_krunt – Plot/Land parcel
DP_krundisihtotstarve – Land use purpose of the plot
DP_hoonestus – Building/Construction
DP_juurdep – Access
DP_tehno – Technical infrastructure

5. Conclusion and Future Research

Investigation of existing 2D data

DK401 Smart data table

	A	B	C	D	E	F	G
1	objectID	kruntOID	ehTyyp	arv	pind	korgus	
2	1	1	10	2	1600	10	

plan_ala | DP_krunt | DP_krundisihtotstarve | DP_hoonestus | DP_juurdep | DP_tehno

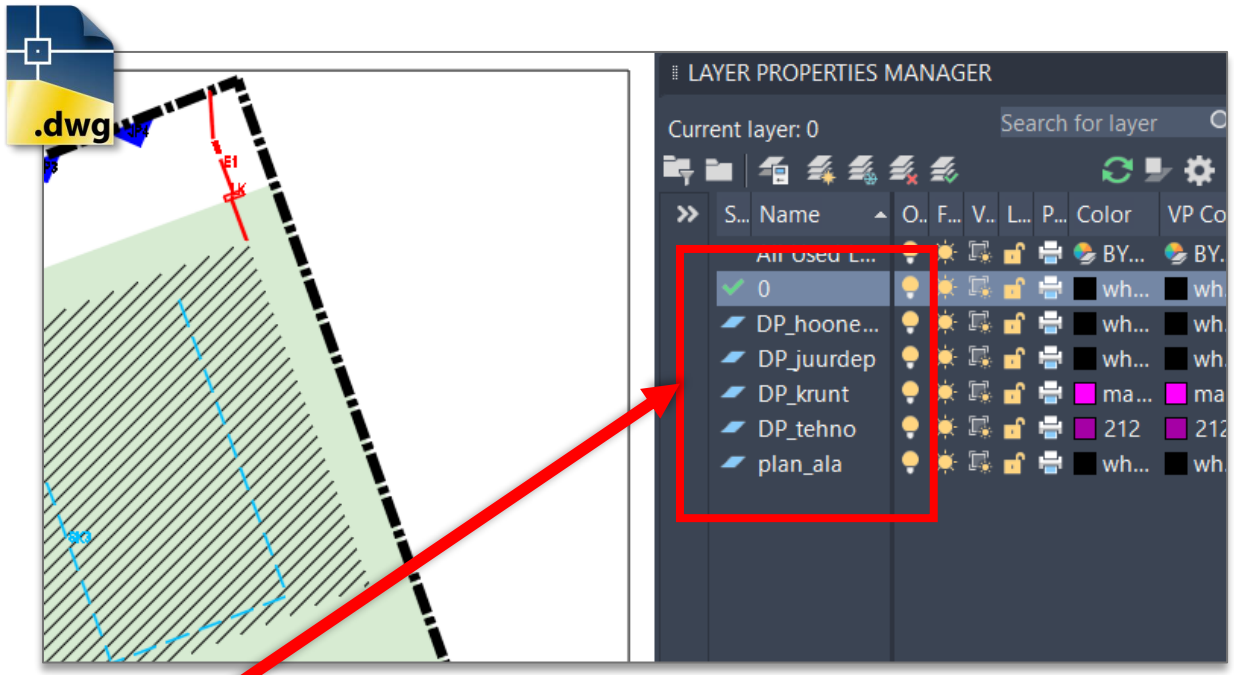
DP_hoonestus
Building/Construction

- **objectID**: Unique identifier for the object in the plan.
- **kruntID:** Identifier for the specific plot/land parcel (krunt).
- **ehTypp:** Type of building/construction allowed on the plot (e.g., residential, commercial).
- **arv:** Number of buildings or units allowed on the plot.
- **pind:** The area of the plot in square meters.
- **korgus:** MAX allowed height of the building in meters.

5. Conclusion and Future Research

Investigation of existing 2D data

DK401 Smart data table



XLSX

	A	B	C	D	E	F	G
1	objectID	kruntOID	ehTyyp	arv	pind	korgus	
2	1	1	10	2	1600	10	

plan_ala | DP_krunt | DP_krundisihtotstarve | DP_hoonestus | DP_juurdep | DP_tehno

The **missing metadata** of the layers from the DWG file seems to be **represented in multiple XLSX (“CSV”) files**.

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data

DK402 Metadata table

DK401 Smart data table

5. Conclusion and Future Research

Investigation of existing 2D data

DK202 Planning solution containing spatial data

DK402 Metadata table

DK401 Smart data table

+

RI100 Spatial illustrations ?

5. Conclusion and Future Research

Investigation of existing 2D data

RI100 Spatial illustrations

Contains **3D renders** of the Detailed Plan

5. Conclusion and Future Research

Investigation of existing 2D data

RI100 Spatial illustrations

- **Primarily used for visualization**
- **Lack the technical information needed** for compliance checks or LADM integration

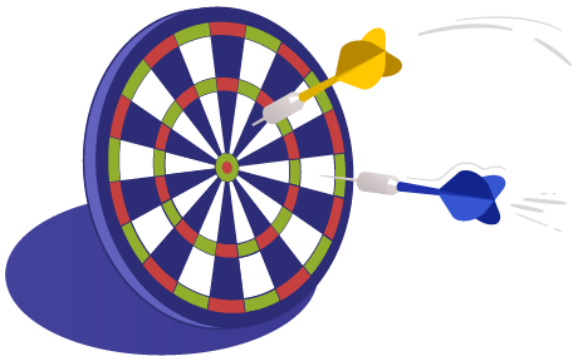
5. Conclusion and Future Research

Investigation of existing 2D data

- **Reliance on 2D data** and **fragmented metadata** creates challenges in Estonia's spatial planning system.
- Data in PLANK **can be adapted for LADM Part 5** and **compliance checking, but significant workflow adjustments are required**.
- **Improvements needed:**
  - adding richer semantic information,
  - streamlining metadata,
  - reducing reliance on external files.

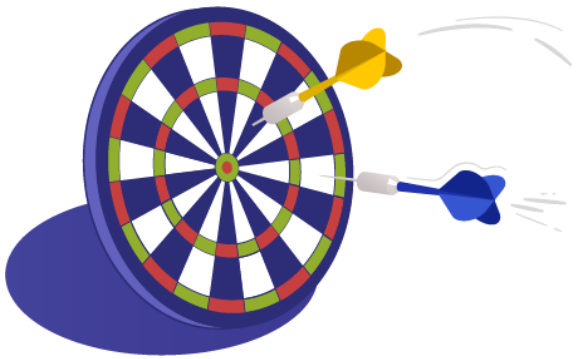
5. Conclusion and Future Research

- **LADM Part 5 profile** for Estonia **enhances data consistency** and **interoperability** across spatial planning checks.



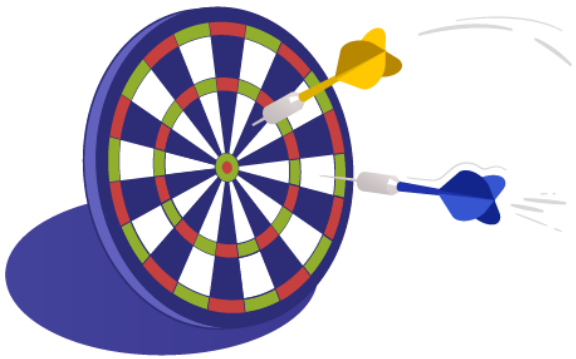
5. Conclusion and Future Research

- LADM Part 5 profile for Estonia enhances data consistency and interoperability across spatial planning checks.
- A **standardized and structured database enables effective management** and **validation** of plan data.



5. Conclusion and Future Research

- LADM Part 5 profile for Estonia enhances data consistency and interoperability across spatial planning checks.
- A standardized and structured database enables effective management and validation of plan data.
- Examining the **existing 2D system** alongside the proposed solution **highlights LADM Part 5's role in unifying fragmented data.**



5. Conclusion and Future Research

Addressing to common reviews

Why 3D data/ why IFC?

- 3D data in IFC format allows **accurate representation of spatial relationships**, vital for compliance checks.
- **Combines both geometric and semantic data in a single model**, allowing for a streamlined validation process without relying on fragmented sources like CSV files.
- **Embeds metadata within the model itself,** allowing automation to be established easier without relying on manual interventions.
- IFC, as an open standard, **enhances interoperability and aligns Estonia with global practices**.

5. Conclusion and Future Research

Addressing to common reviews

Why import scripts only focus on Detailed Plans?

- Focused on Detailed Plans due to the **availability of 3D IFC data** and **the scope of the research** focusing on IFC rather than WMS//WFS (Master Plan data).
- However, LADM country profile and the database were structured to **accommodate future inclusion of Master Plans**.
- Using Detailed Plans as a starting point ensures a practical implementation of compliance checks, **setting the groundwork for expansion.**

5. Conclusion and Future Research

Addressing to common reviews

How does this research address key challenges in spatial planning?

- **Standardizes spatial data management** by implementing LADM Part 5, enhancing consistency across municipalities and planning levels.
- Highlights the benefits of adopting 3D IFC models, enabling further applications like compliance checks.
- **Streamlines data exchange between planning authorities**, improving collaboration and reducing data inconsistencies.
- **Lays a foundation for automated compliance checks**, supporting Estonia's broader digitalization goals in spatial planning.

5. Conclusion and Future Research

Scale	Scale the prototype to real-world workflows with larger datasets.
Improve	Improve IFC-LADM mapping and standardize urban-scale data use.
Explore	Explore CityGML's potential for planning and zoning checks.
Establish	Establish consistent frameworks for Estonian spatial planning data.
Integrate	Integrate additional LADM standards for comprehensive systems.
Test	Test LADM Part 5 in diverse countries and planning contexts.
Develop	Develop advanced algorithms for more thorough compliance checks.

Thank you.

References used for the Presentation

https://www.freepik.com/ (illustrations)
https://eehitus.ee/wp-content/uploads/2024/02/Final-work-report-PlanBIM-project-Estonia.pdf
https://planeeringud.ee/plank-web/#/planning