

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

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Second supervisor: Eftychia Kalogianni
Company supervisor: Marjan Broekhuizen
Co-reader: Dr.ir. Bastiaan van Loenen

Cadastral Distance check WARNING
Part of buildable area outside of
plot boundary

Cadastral Distance check
SUCCESS!

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1. Introduction



KLIIMAMINISTEERIUM

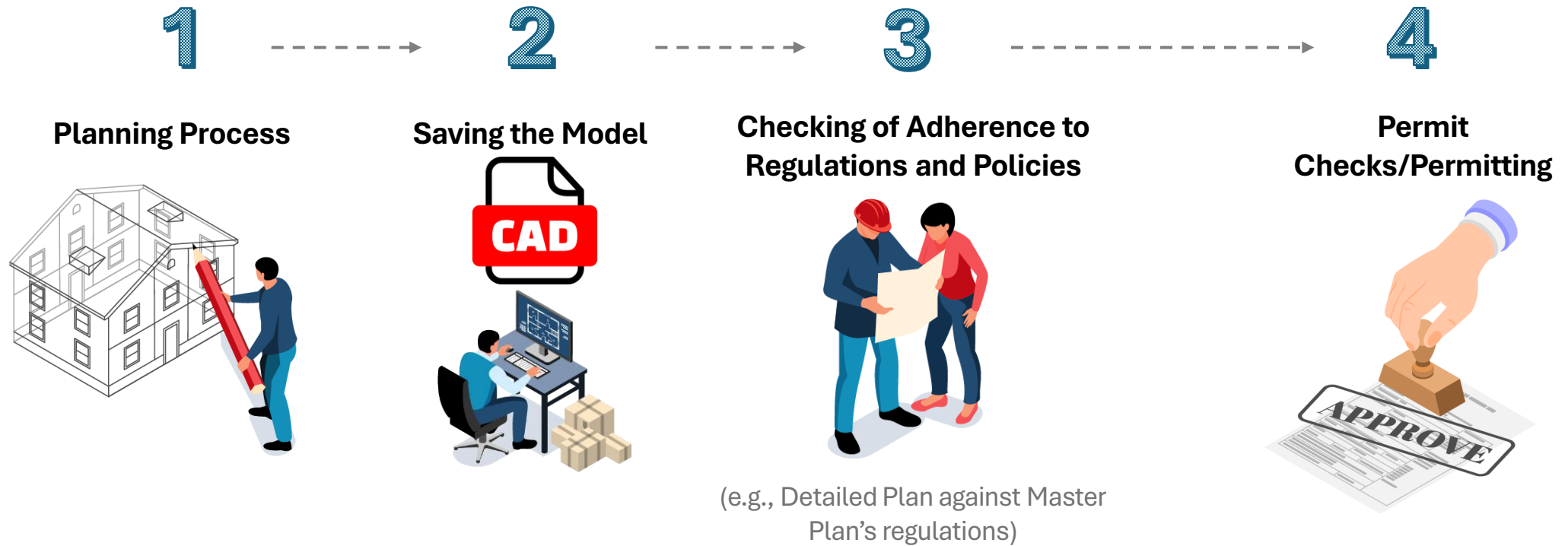
Collaboration with Future Insight

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. Introduction

Research Problem



Manual plan permitting

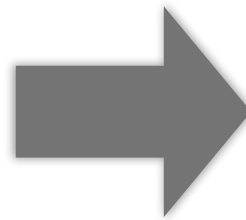
- Prolonged processing times
- Increased potential for errors
- Limited collaboration among stakeholders

1. Introduction

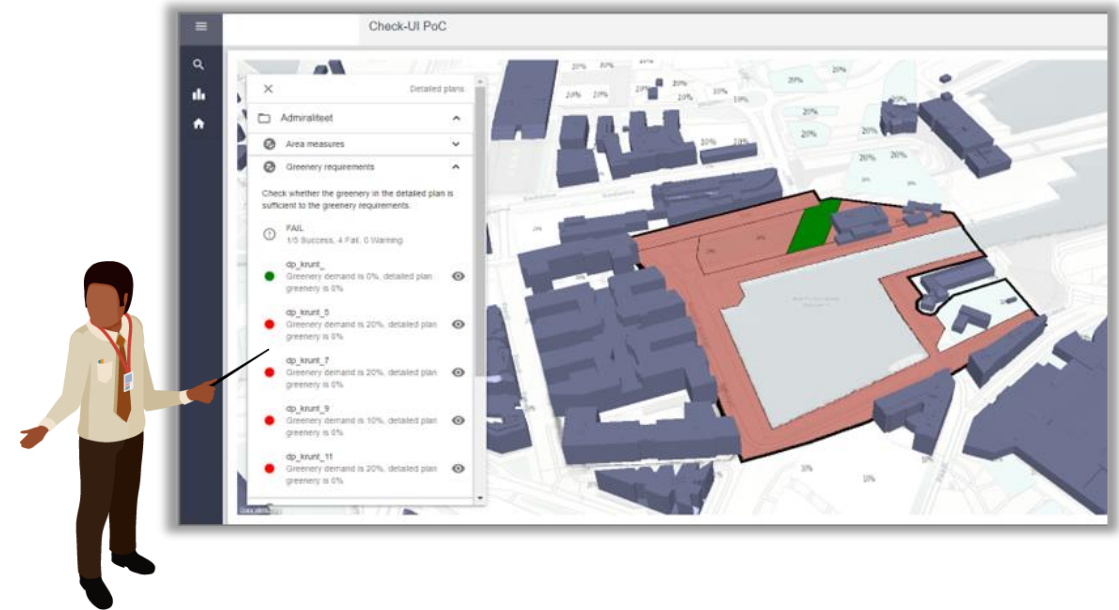
Research Problem



Manual plan permitting



Recognizing the shortcomings
of this manual system



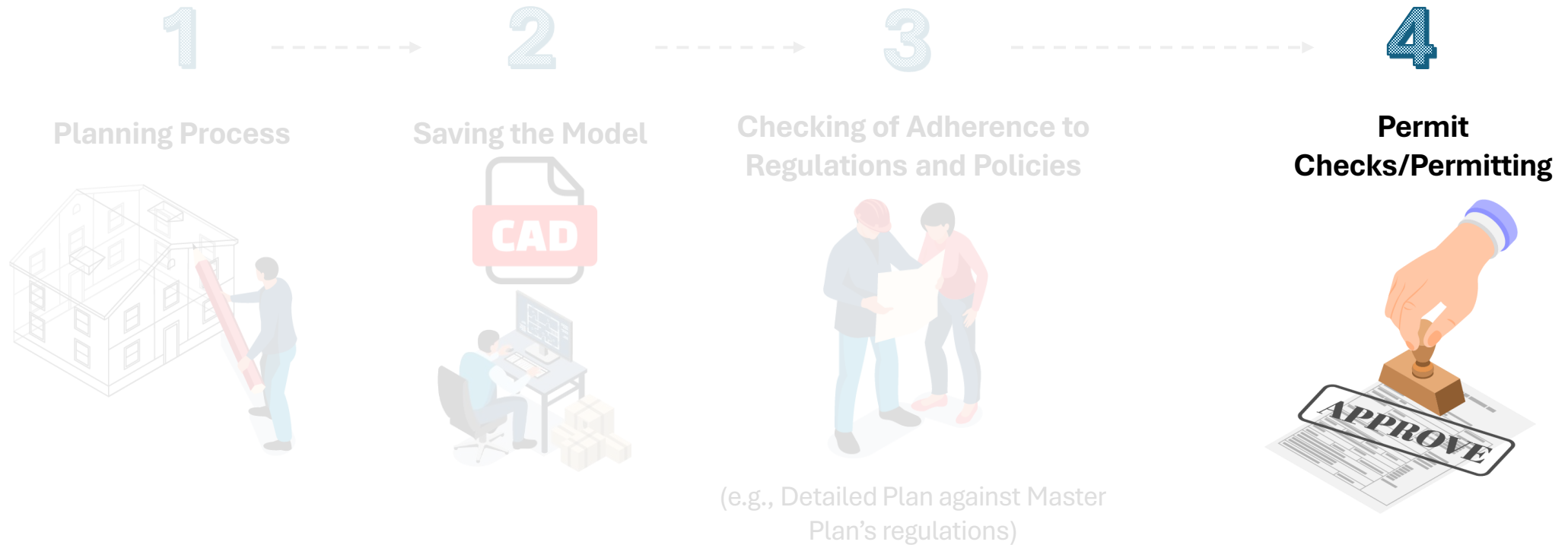
Using BIM/IFC models for permitting

1. Introduction

Research Problem

From Planning Stage to Permitting

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

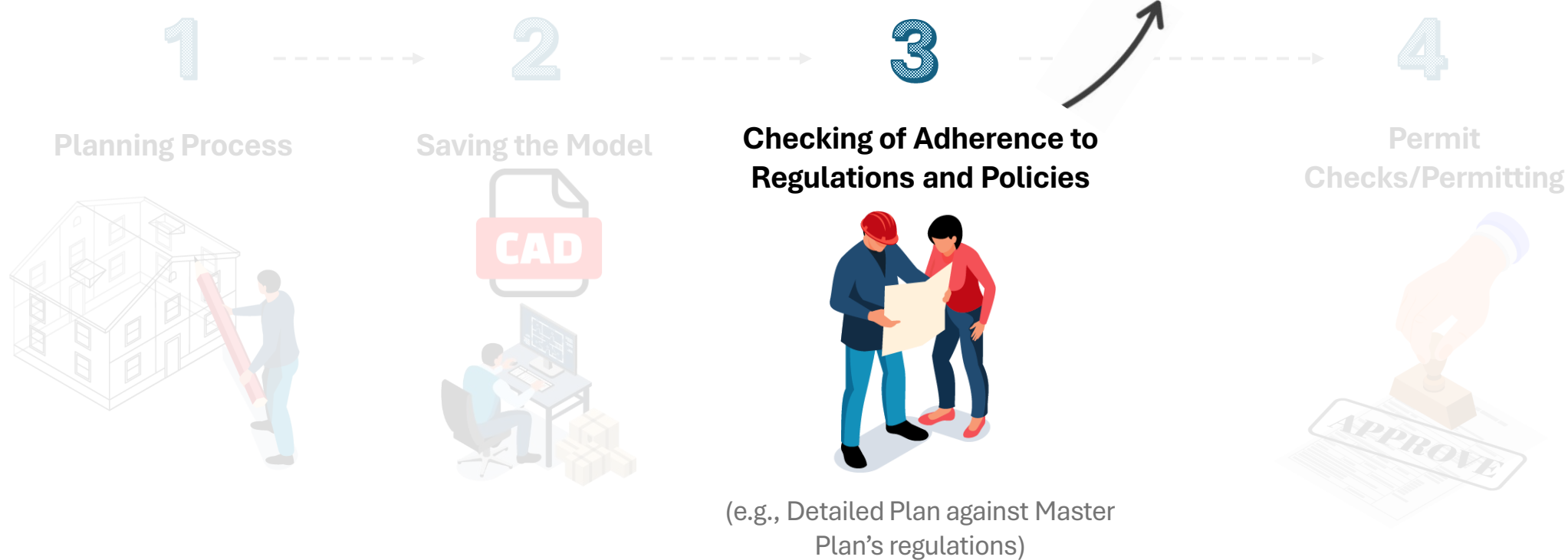


1. Introduction

Research Problem

From Planning Stage to Permitting

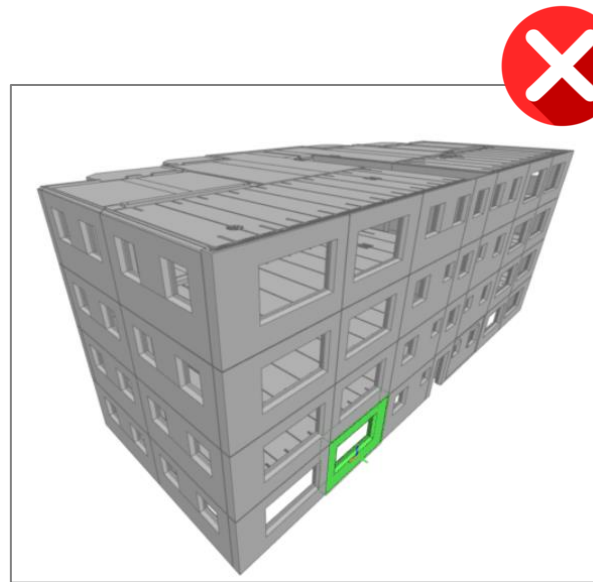
Using BIM/IFC models for early compliance checks streamlines planning and simplifies permitting by ensuring regulations are met before formal applications.



1. 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



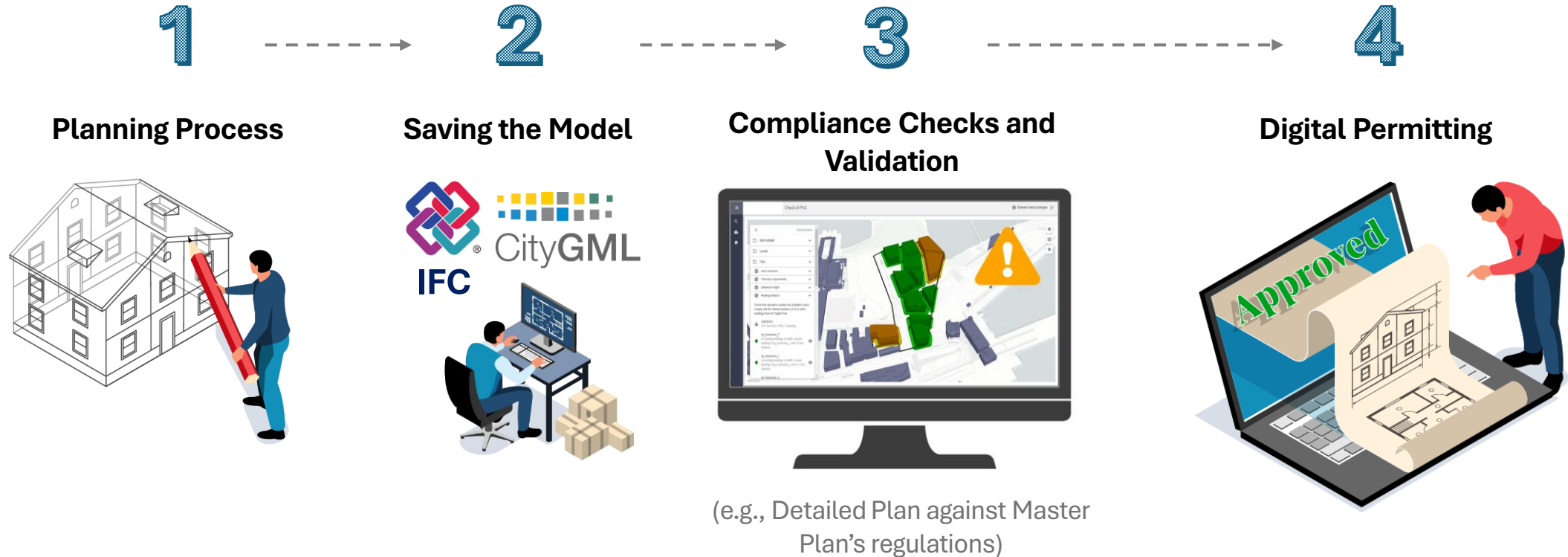
IFC as a
Plan Information Model

1. Introduction

Research Problem

Proposed pipeline

From Planning Stage to Permitting



1. Introduction

Research Problem

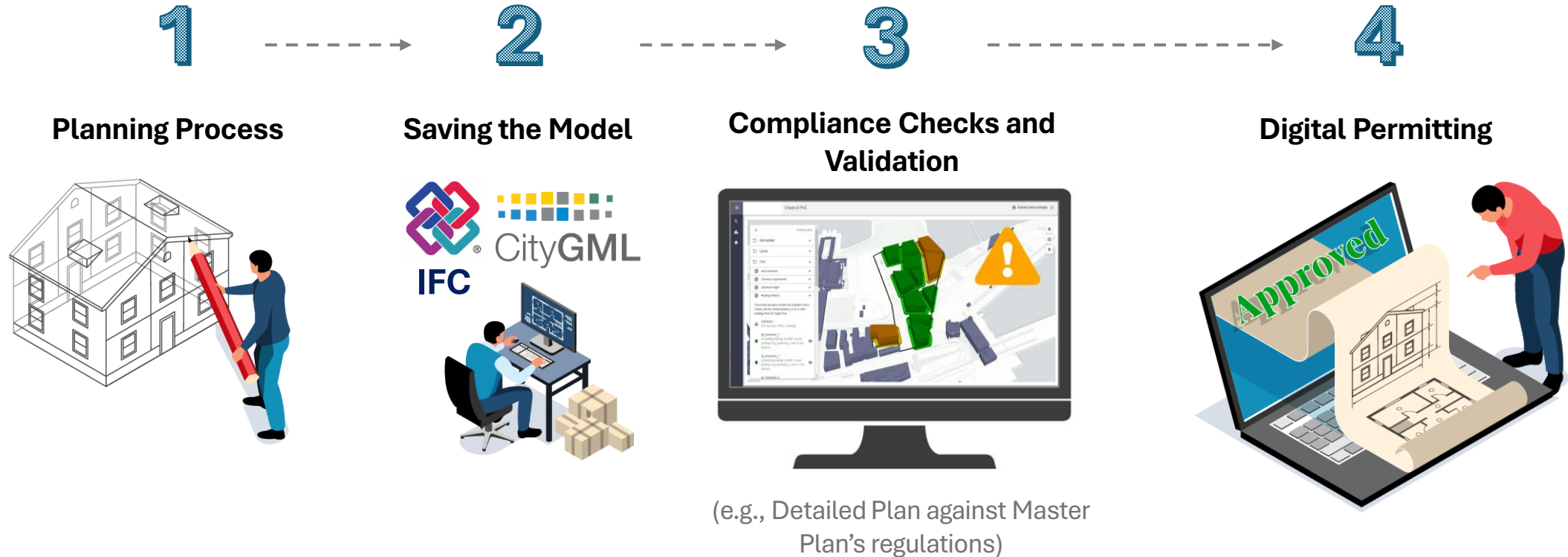
*“How can **BIM/IFC** be leveraged for the **registration of spatial plans and compliance checking** in Estonia, utilizing **LADM Part 5 Spatial Plan Information (ISO19152-5)**?”*

1. Introduction

Research Problem

Proposed pipeline

From Planning Stage to Permitting

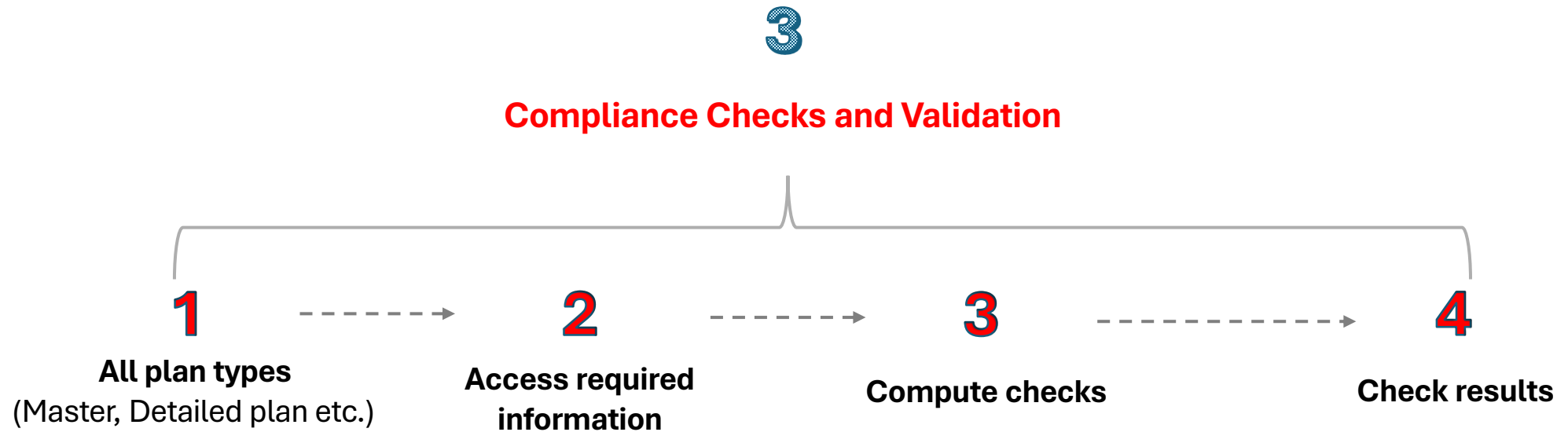


1. Introduction

Scope

Proposed pipeline

From Planning Stage to Permitting



1. Introduction

Scope

1

All plan types
(Master, Detailed plan etc.)



2

Access required
information



3

Compute checks



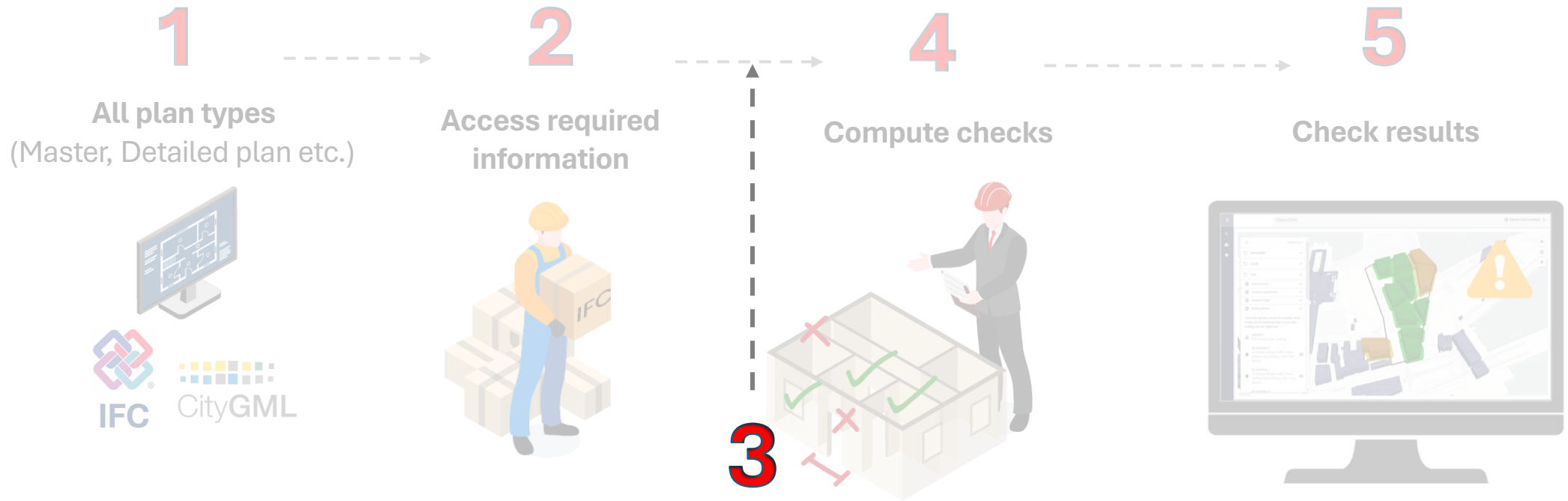
4

Check results



1. Introduction

Scope

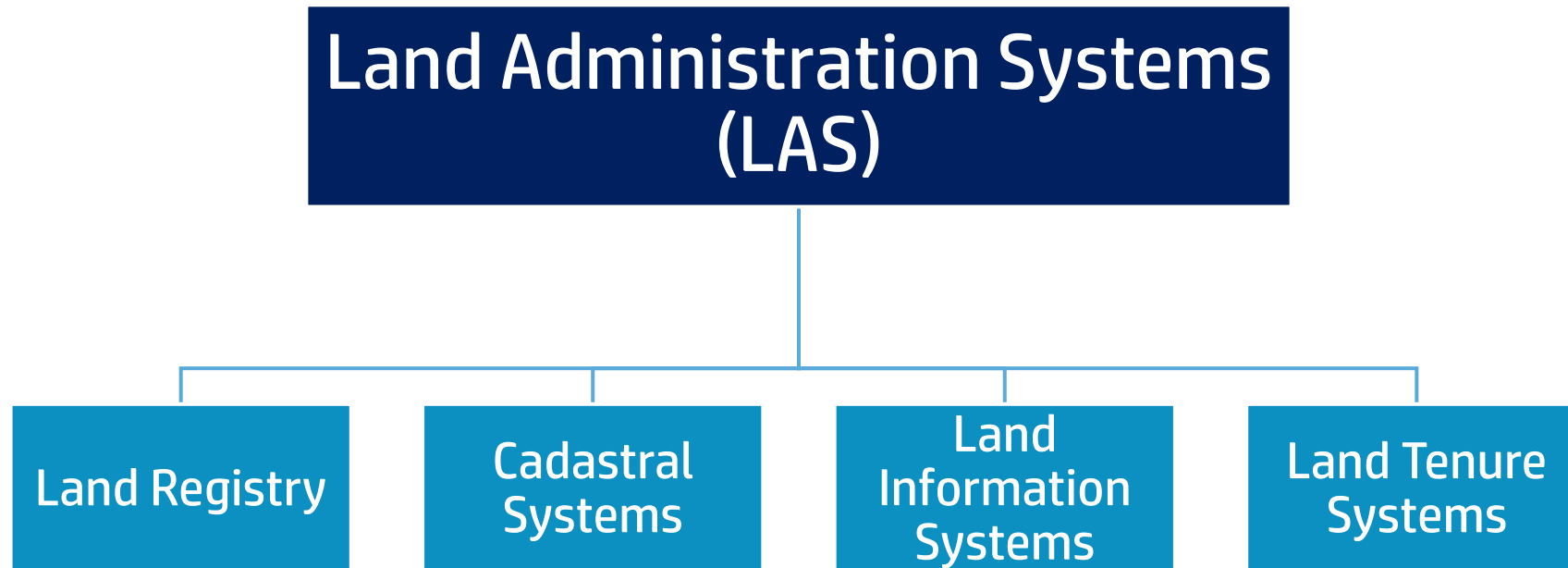


Store information through LADM

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

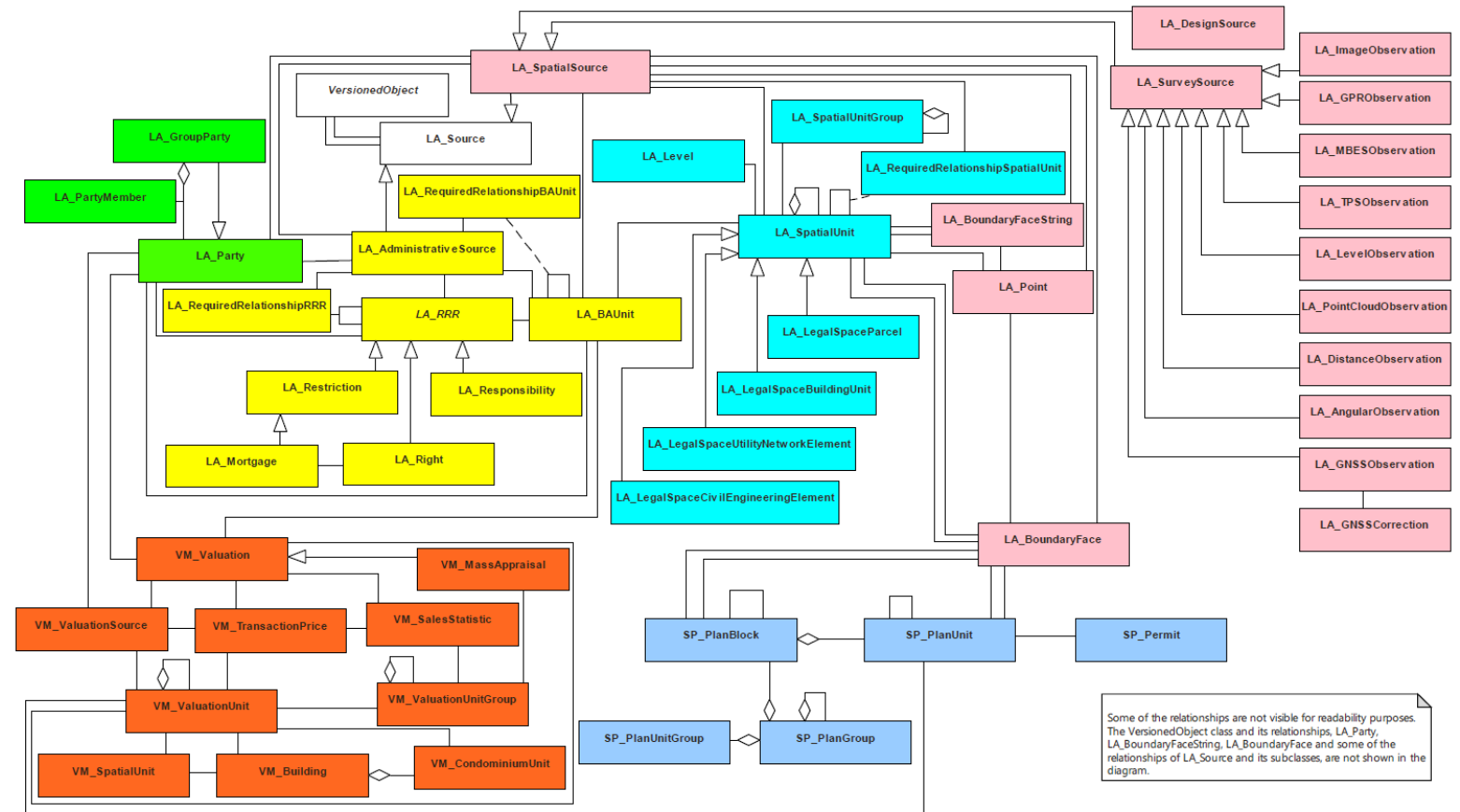


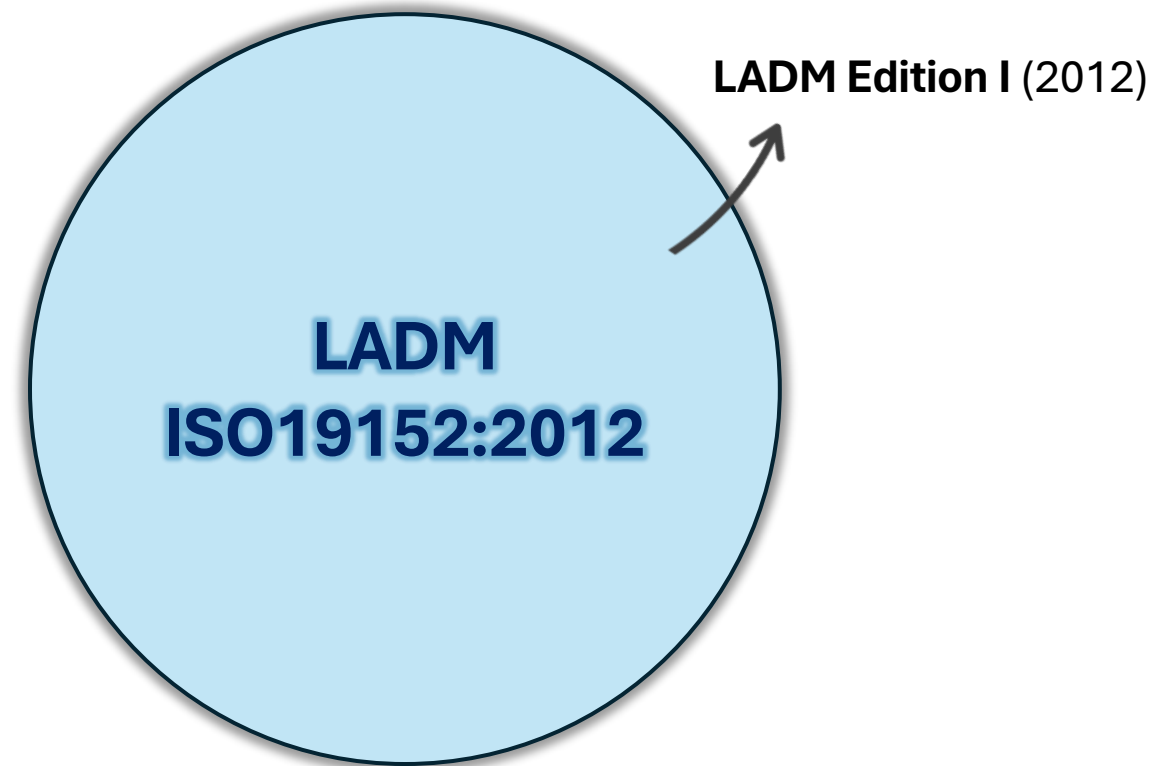
Fig. LADM Edition II parts 1, 2, 4 and 5 and their relationship (Kara et al. 2024)

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).

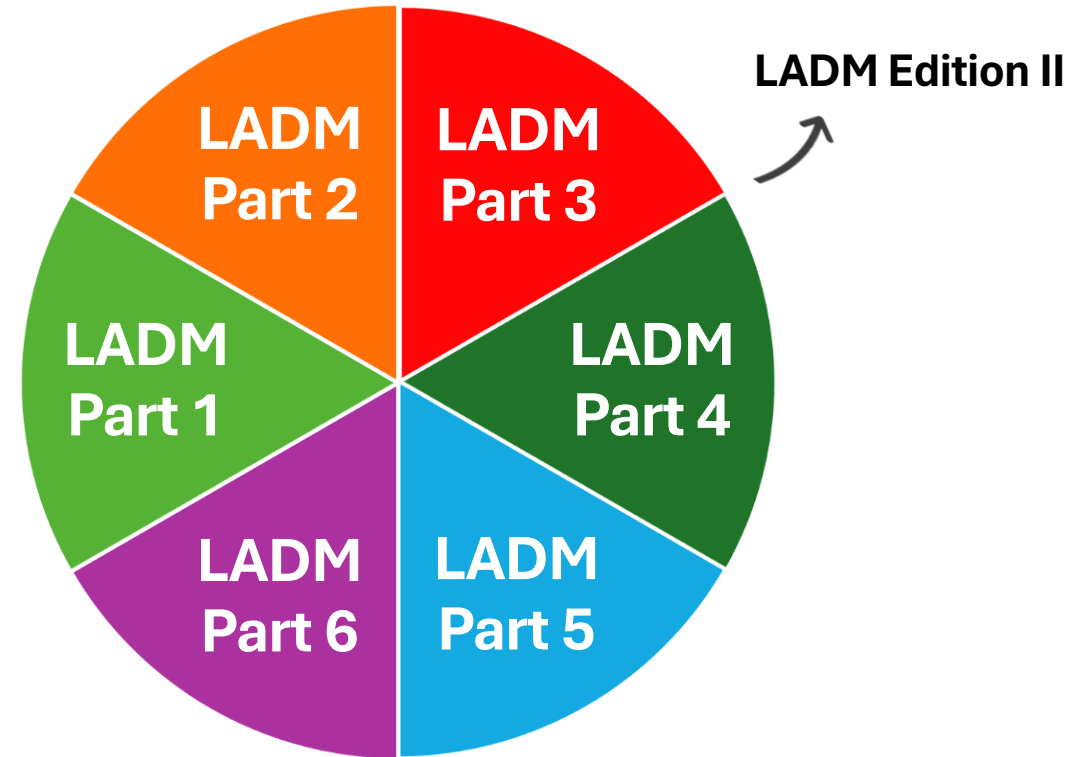


1. Introduction

LADM

LADM Edition II

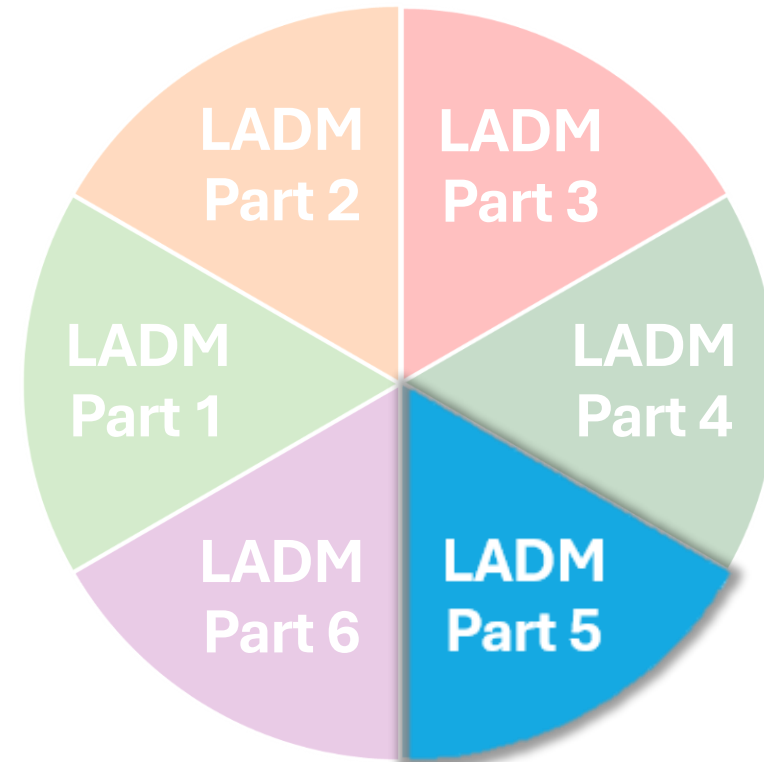
- **Part 1:** Generic Model
- **Part 2:** Land Registration
- **Part 3:** Marine Georegulation
- **Part 4:** Valuation Info
- **Part 5:** Spatial Plan Info
- **Part 6:** Implementation



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

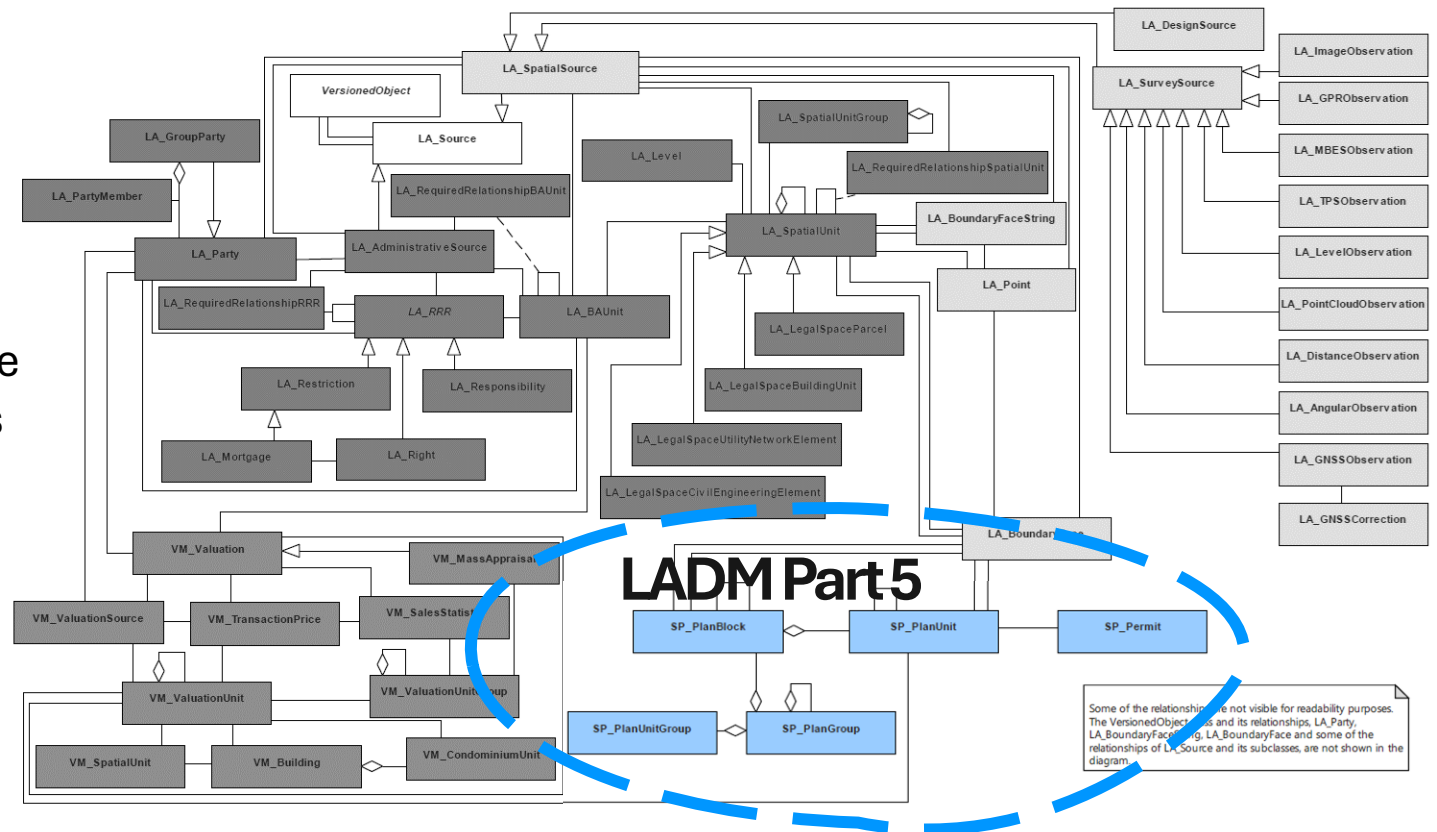
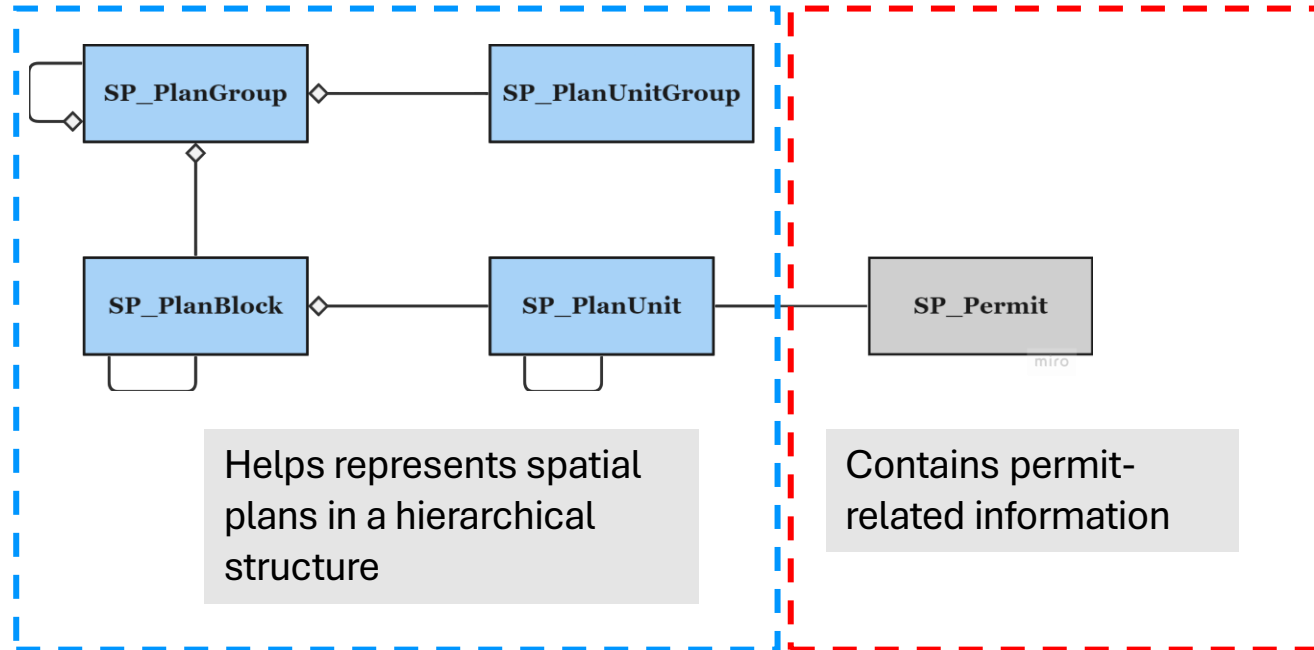


Fig. LADM Edition II parts 1, 2, 4 and 5 and their relationship (Kara et al. 2024)

1. Introduction

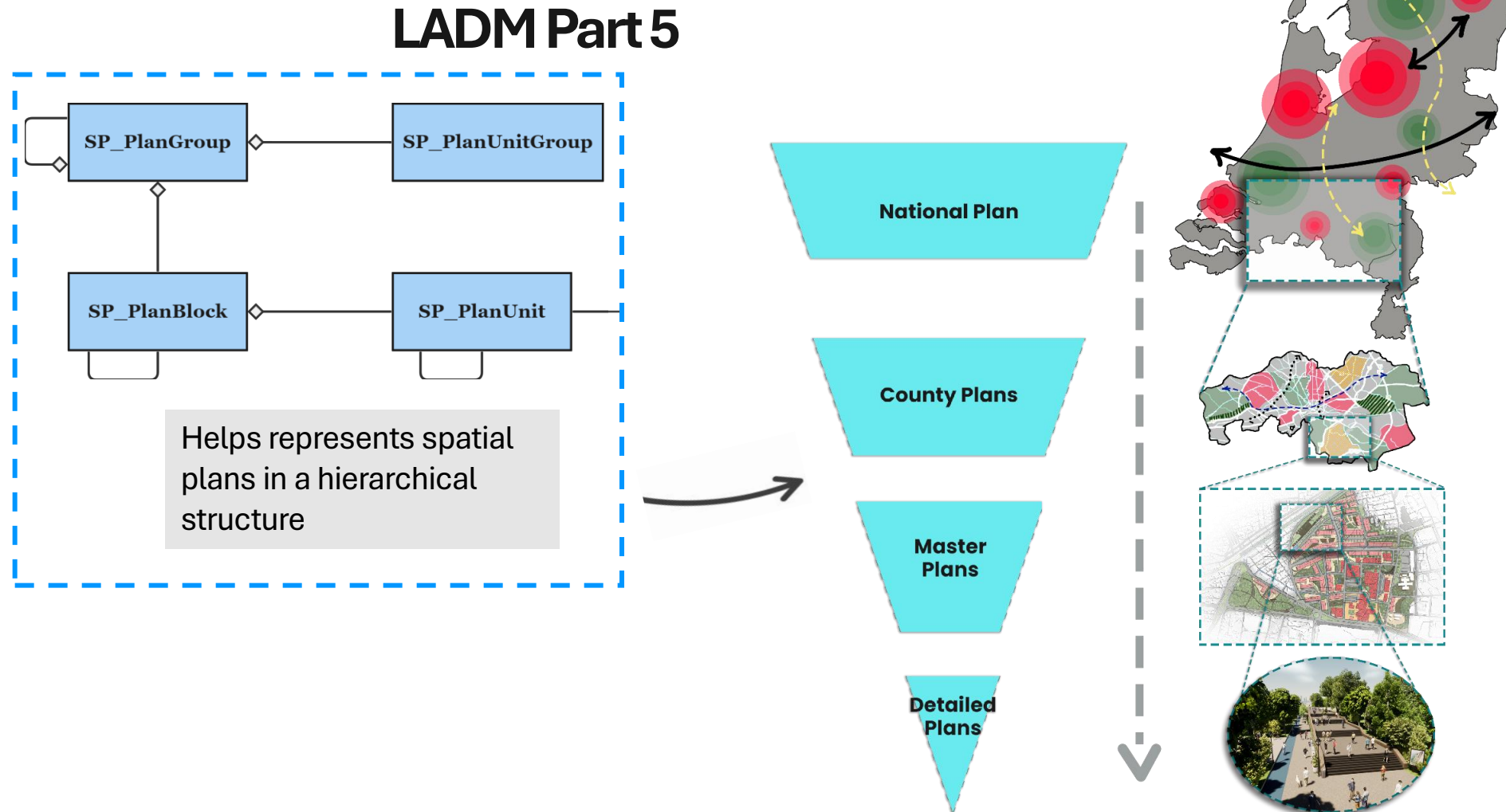
LADM Part 5

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

RôşţġsêŞĹL'

3. Develop an import script to import plans to the database

GŃÉ

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

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

3. Develop an import script to import plans to the database

4. Integration with the compliance checks

RõştfôşêŞŖL'

GŃÉ

2. Case Study: Estonia

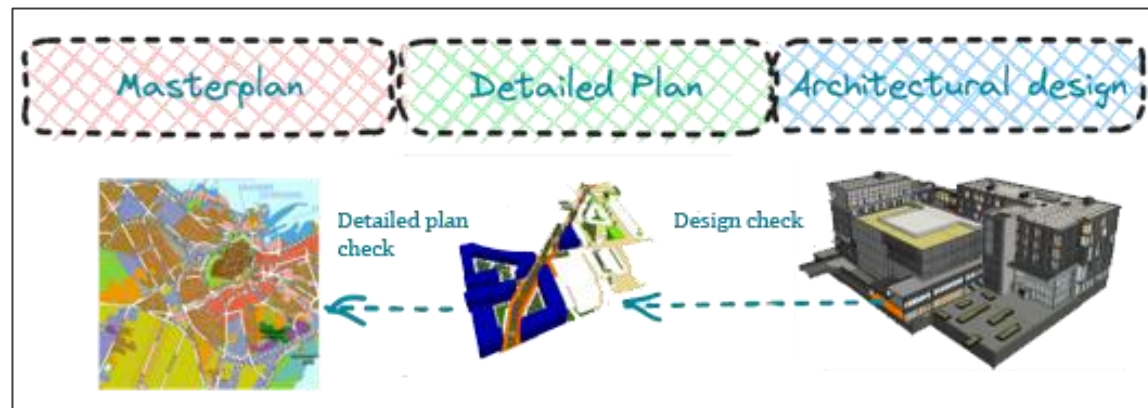
Relevant Projects with Estonia

2023 - 2024



Automated Plan Compliance checks

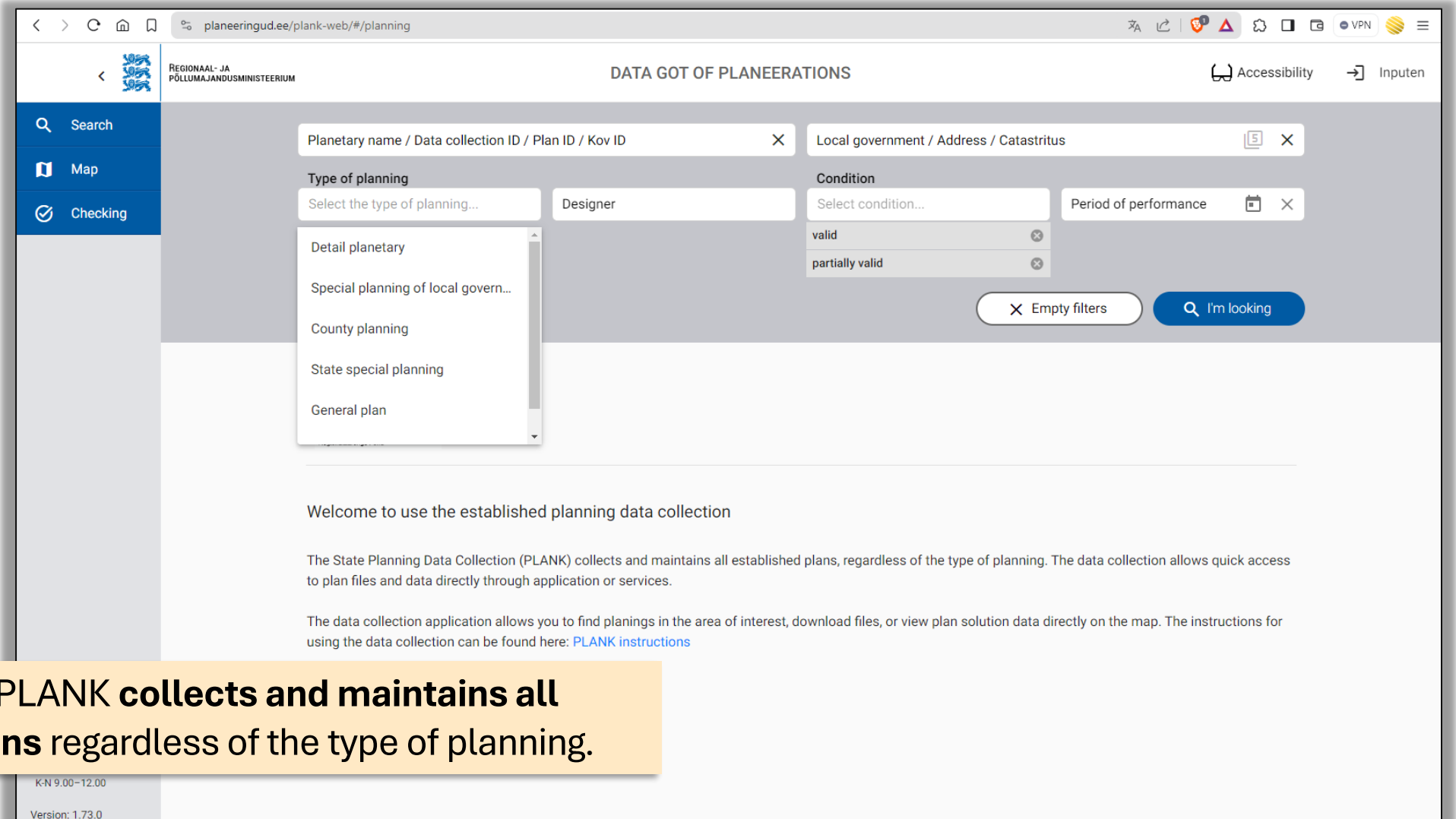
The project aims to apply **BIM-based compliance checks** in the earlier submission and review steps of Detailed Plans, requiring different techniques and data.



2. Case Study: Estonia

Estonia's PLANK

Planetary Data Collection (*PLANK*) platform



The screenshot displays the PLANK web application interface. The browser address bar shows the URL `planeeringud.ee/plank-web/#/planning`. The page header includes the logo of the Regional and Local Planning Department (REGIONAAL- JA PÖLLUMAJANDUSMINISTEERIUM) and the title "DATA GOT OF PLANEERATIONS". The interface features a search bar with the text "Planetary name / Data collection ID / Plan ID / Kov ID" and a filter for "Local government / Address / Catastritus". Below these are filters for "Type of planning" (with a dropdown menu open showing options: Detail planetary, Special planning of local govern..., County planning, State special planning, General plan), "Condition" (with options: valid, partially valid), and "Period of performance". A search button labeled "I'm looking" and an "Empty filters" button are also visible. The main content area contains a welcome message and instructions on how to use the platform.

Welcome to use the established planning data collection

The State Planning Data Collection (PLANK) collects and maintains all established plans, regardless of the type of planning. The data collection allows quick access to plan files and data directly through application or services.

The data collection application allows you to find planings in the area of interest, download files, or view plan solution data directly on the map. The instructions for using the data collection can be found here: [PLANK instructions](#)

K-N 9.00-12.00
Version: 1.73.0

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

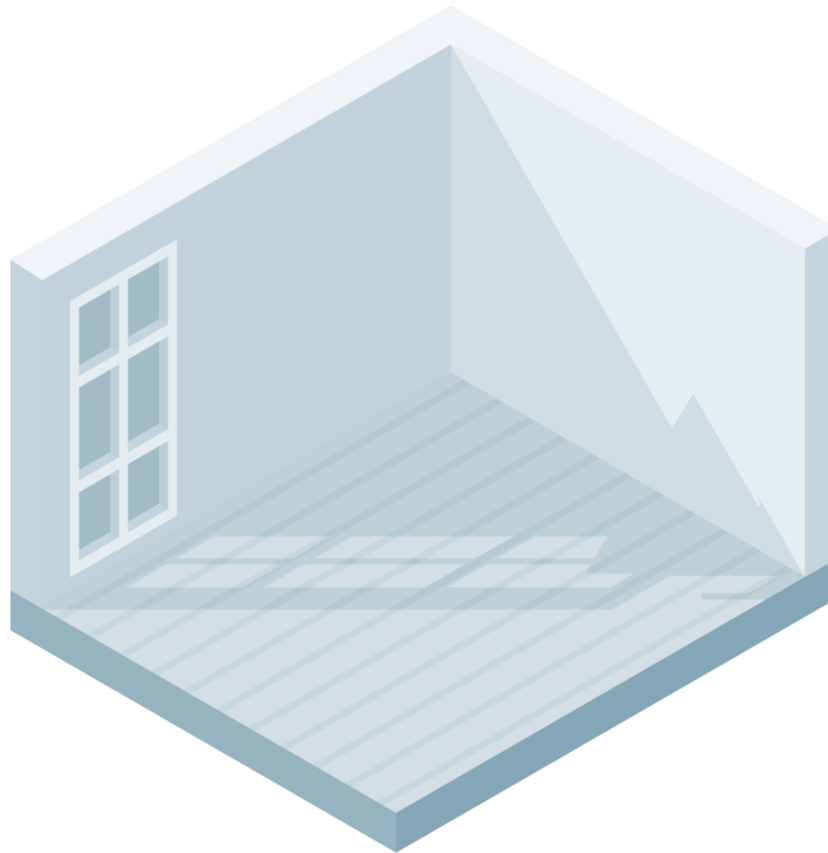
3. Estonia country profile

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.

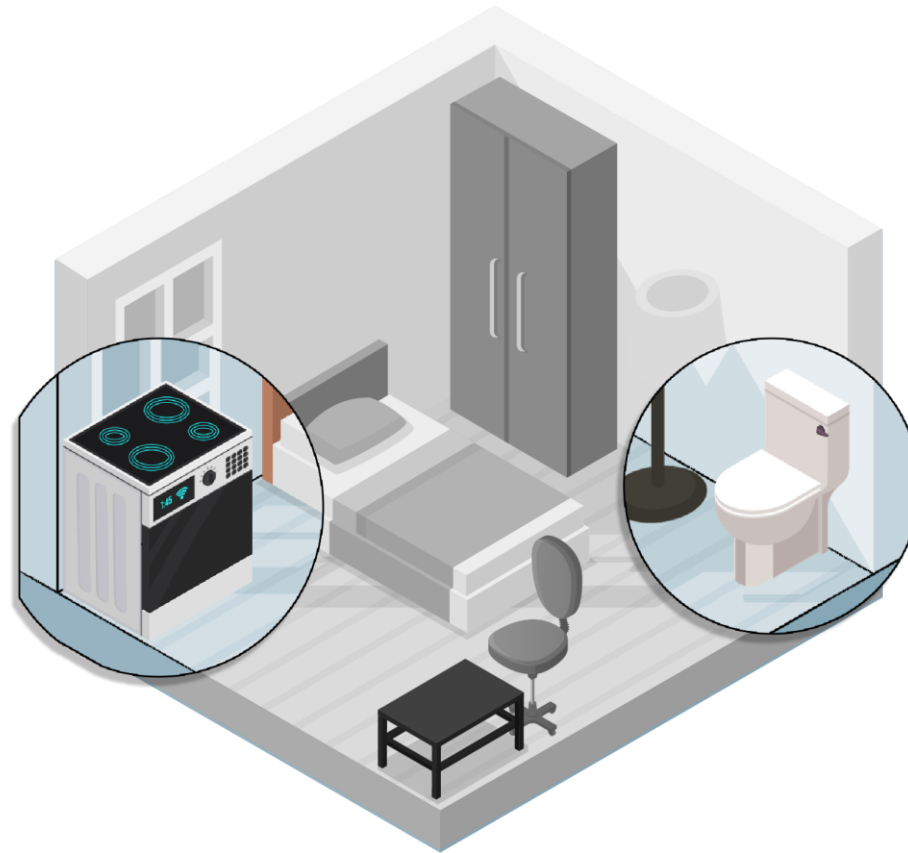
3. Estonia country profile

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

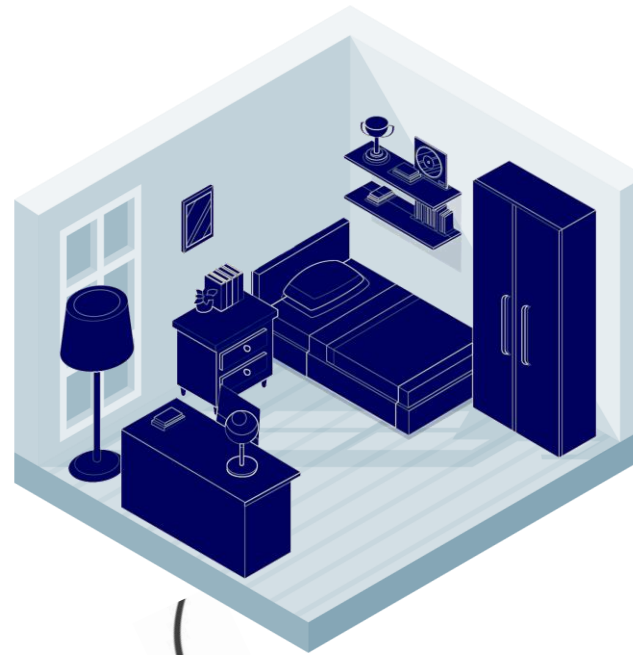
Why do we need a country profile?

1.

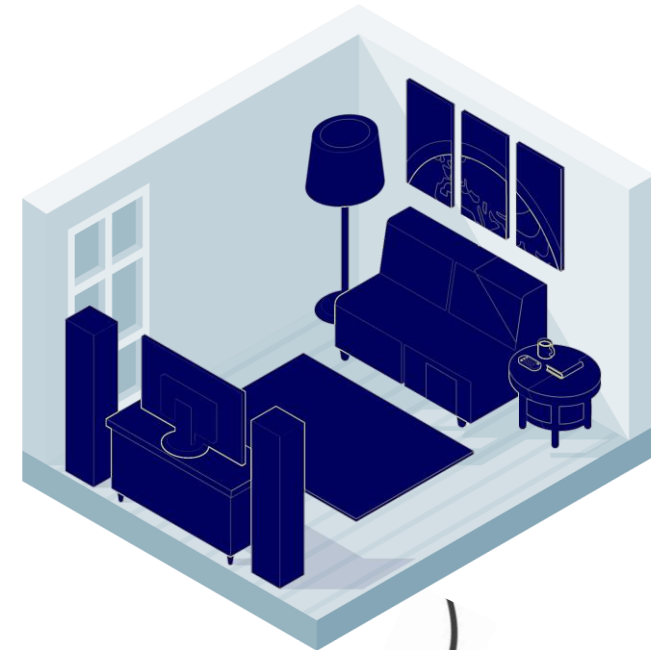
Create a country profile for Estonia in LADM Part 5

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

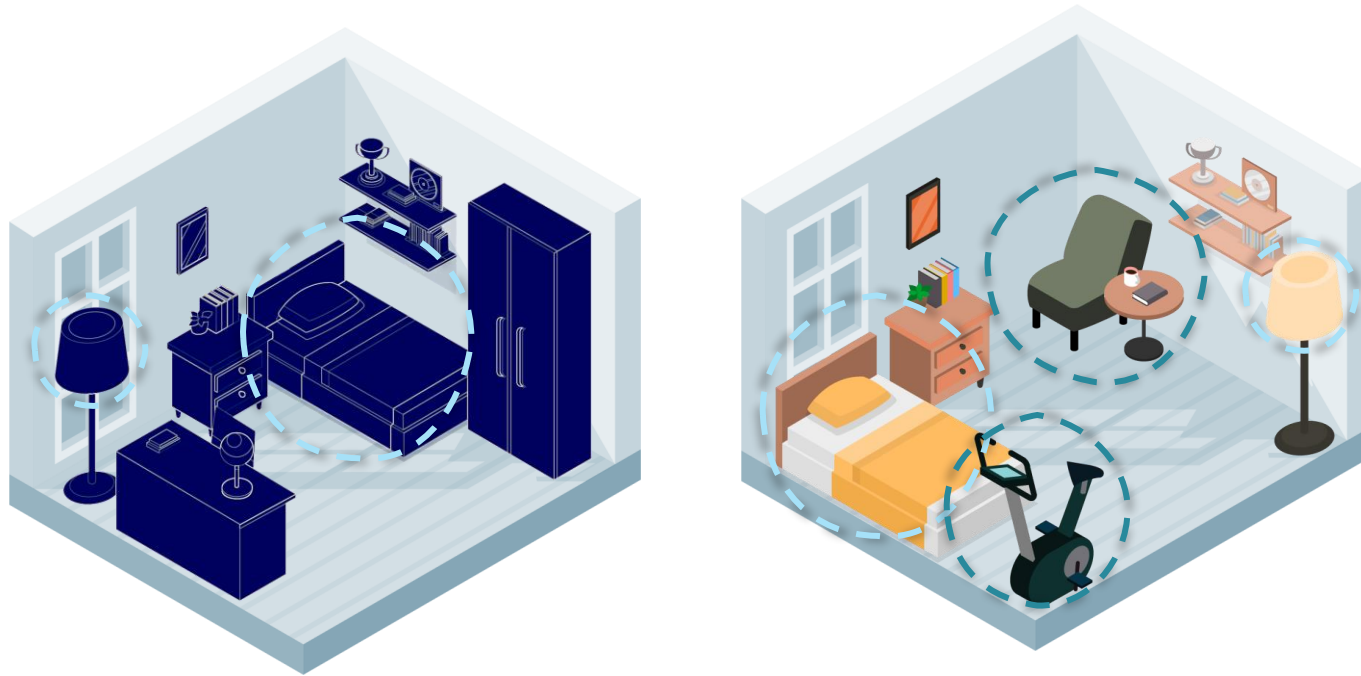
3. Estonia country profile

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!

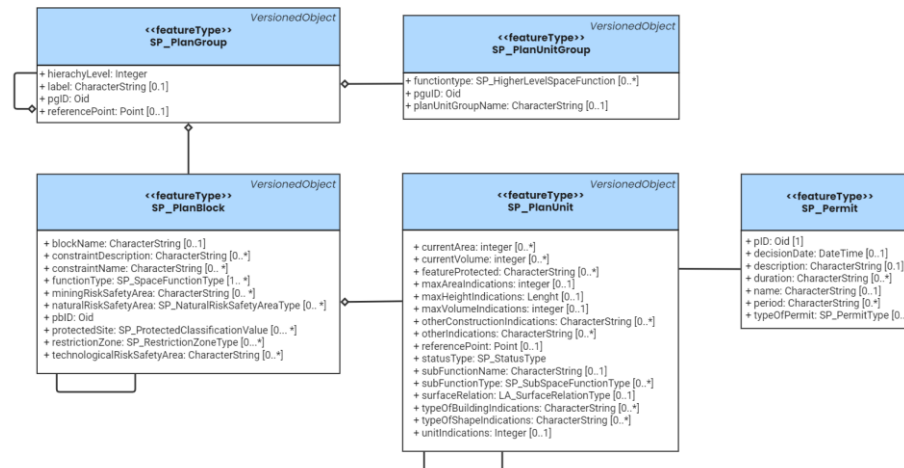
3. Estonia country profile

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

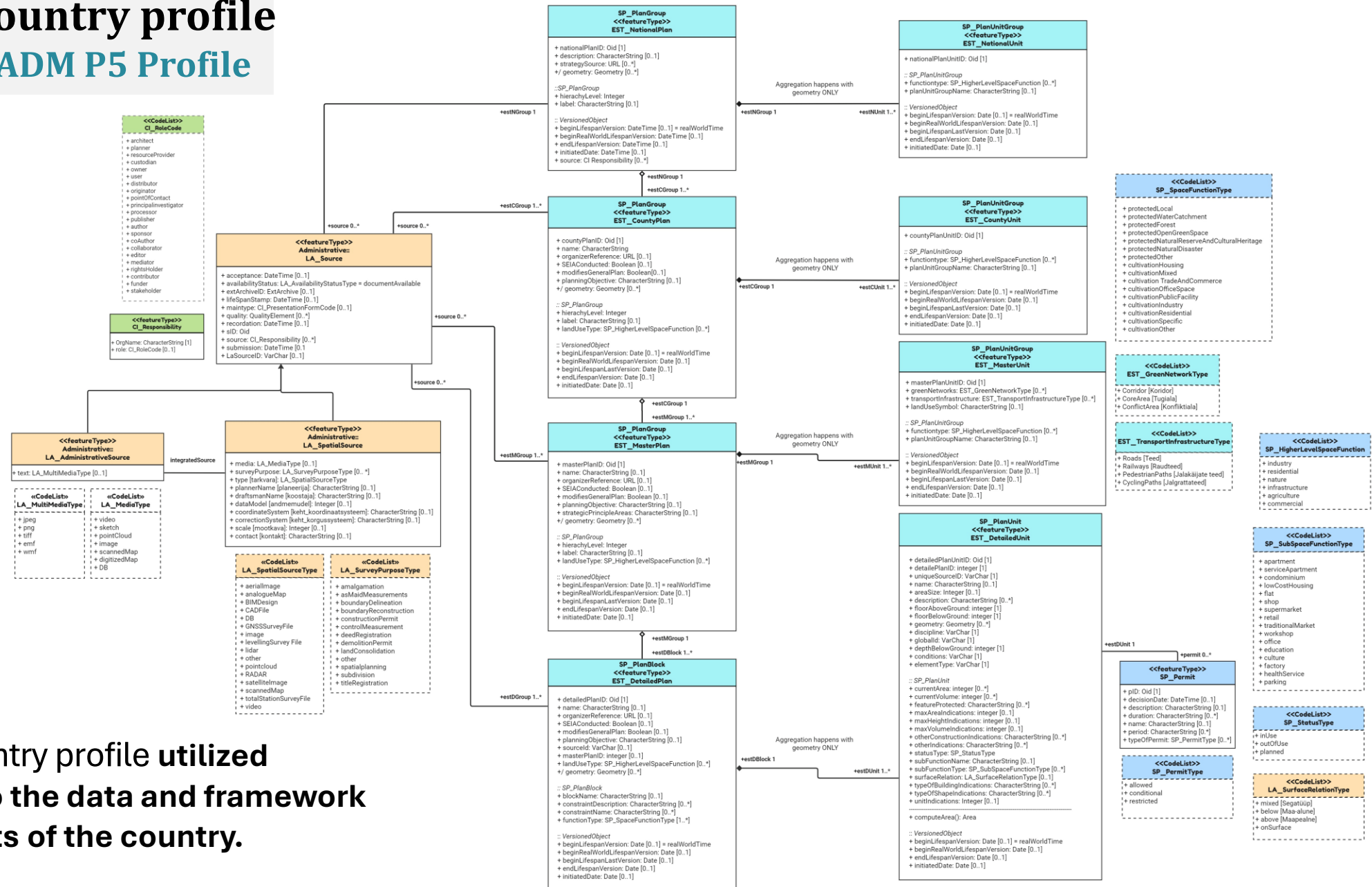


LADM P5's **proposed structure** to store the spatial information

(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.

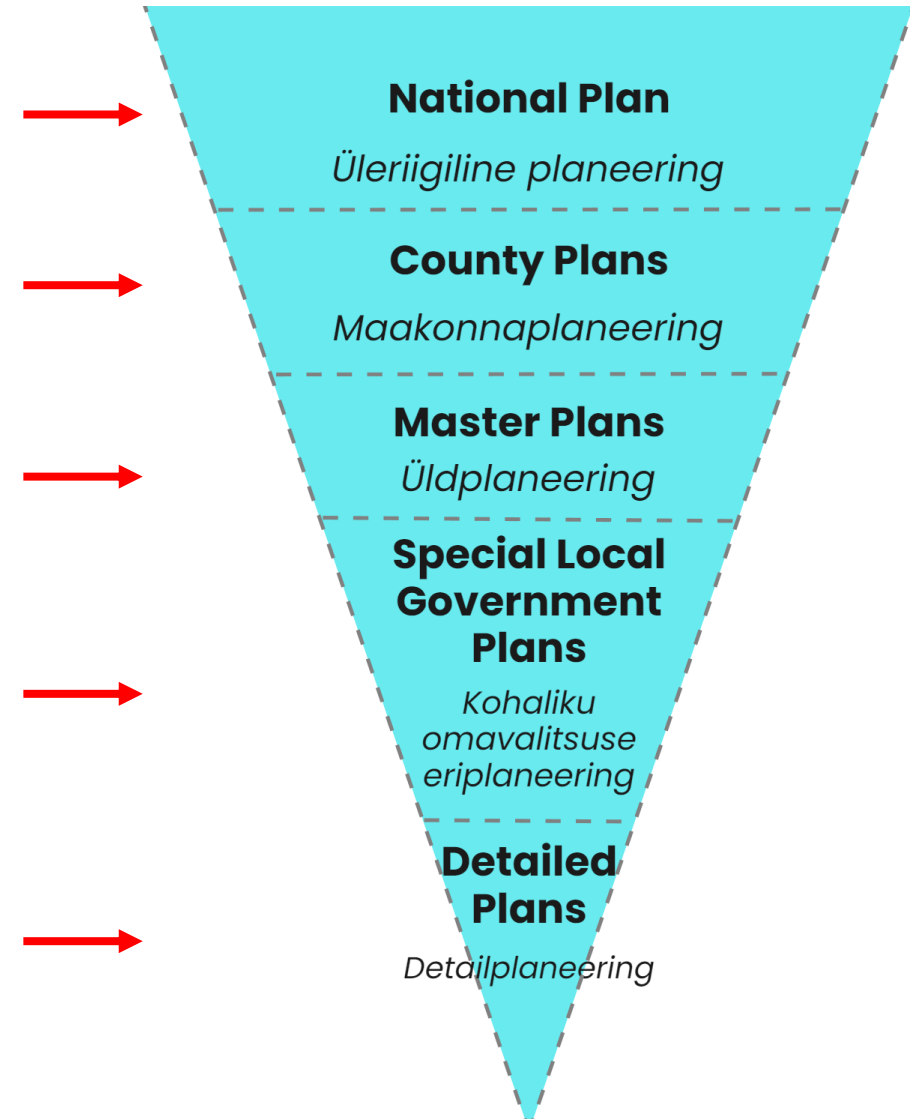
3. Estonia country profile

LADM Part 5 mapping

LADM Classes

<<featureType>> SP_PlanGroup
+ hierarchyLevel: Integer + label: CharacterString [0..1] + pgID: Oid + referencePoint: Point [0..1]
<<featureType>> SP_PlanGroup
+ hierarchyLevel: Integer + label: CharacterString [0..1] + pgID: Oid + referencePoint: Point [0..1]
<<featureType>> SP_PlanGroup
+ hierarchyLevel: Integer + label: CharacterString [0..1] + pgID: Oid + referencePoint: Point [0..1]
<<featureType>> SP_PlanGroup
+ hierarchyLevel: 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

LADM Part 5 mapping

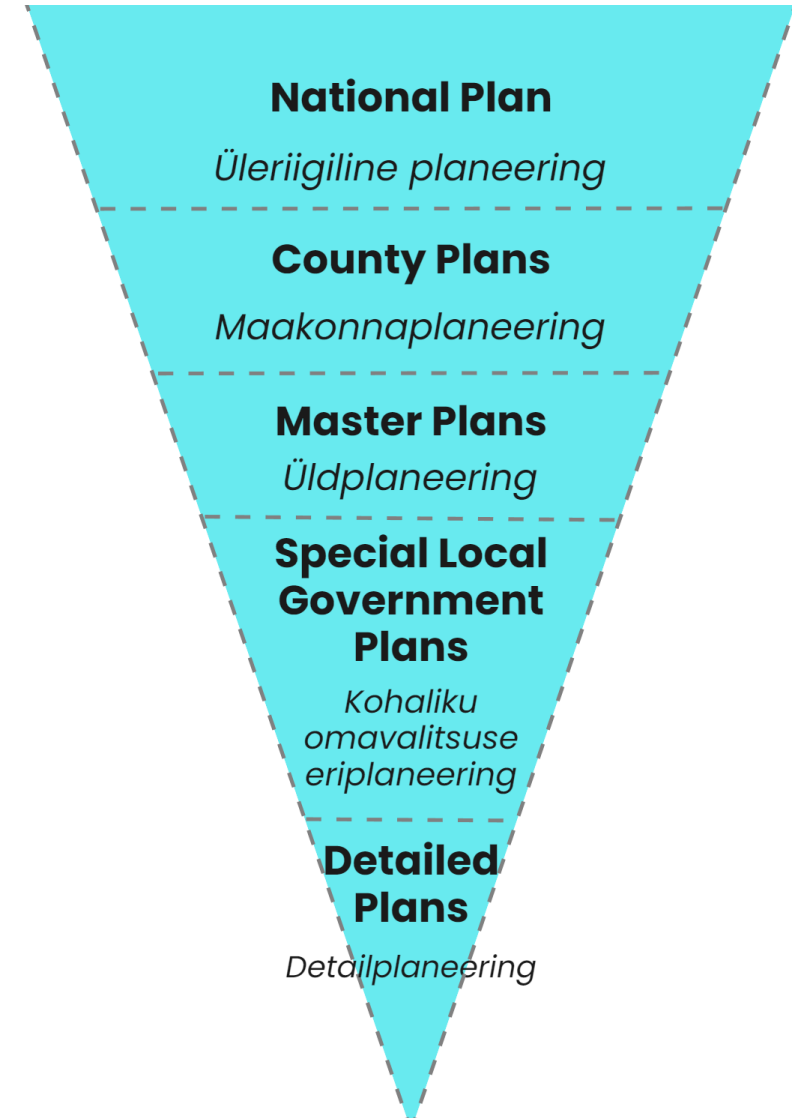
For representing more details for each specific plan level...

<<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..*]

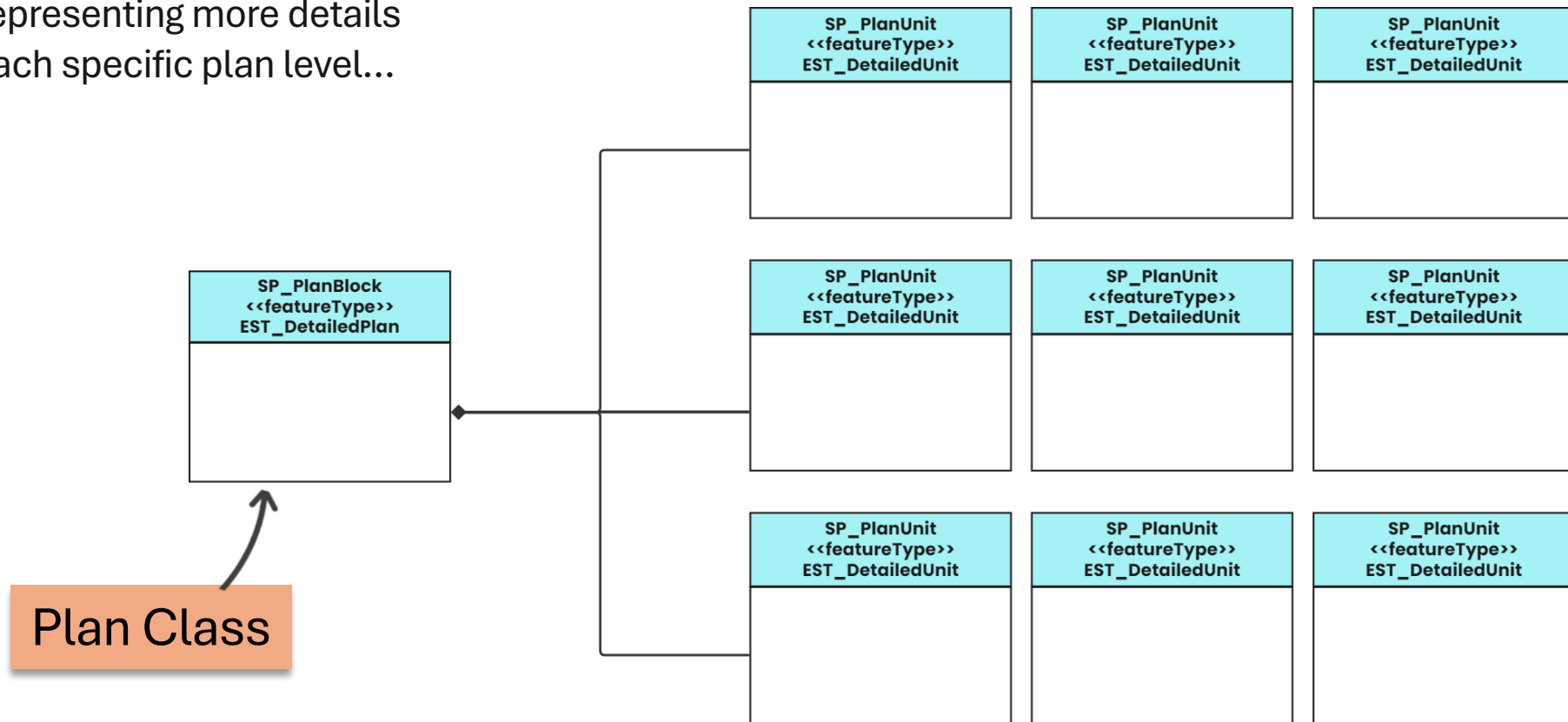
Estonia Spatial Plans



3. Estonia country profile LADM Part 5 mapping

its unit classes

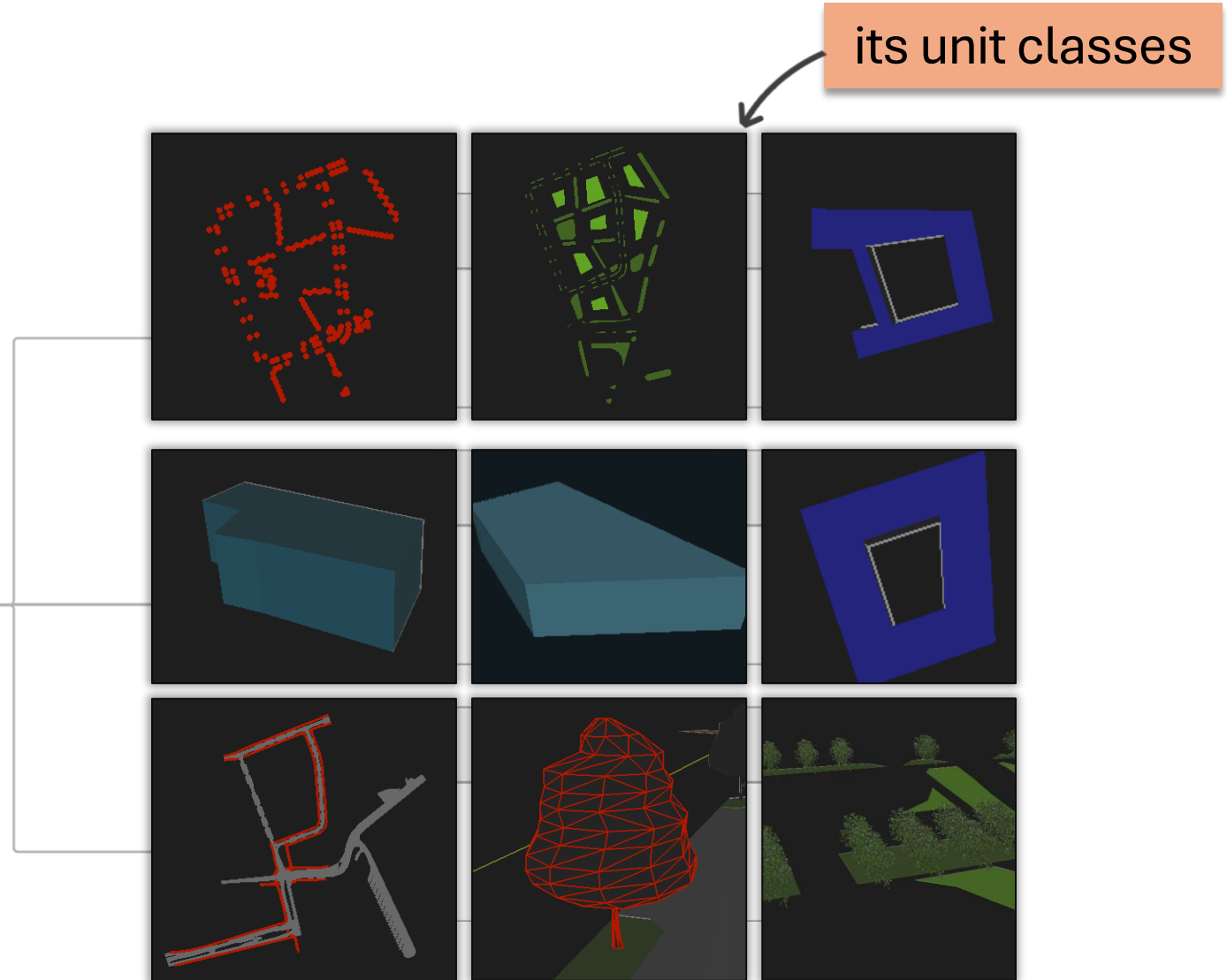
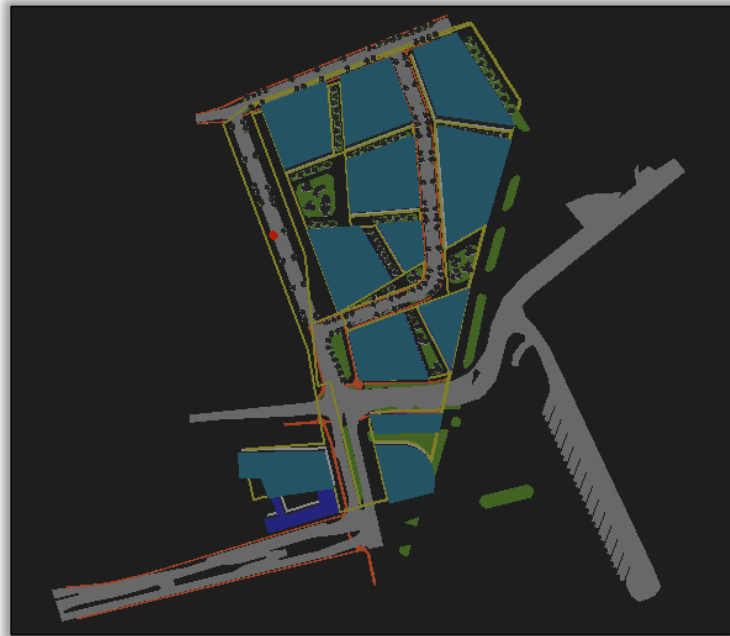
For representing more details
for each specific plan level...



3. Estonia country profile

LADM Part 5 mapping

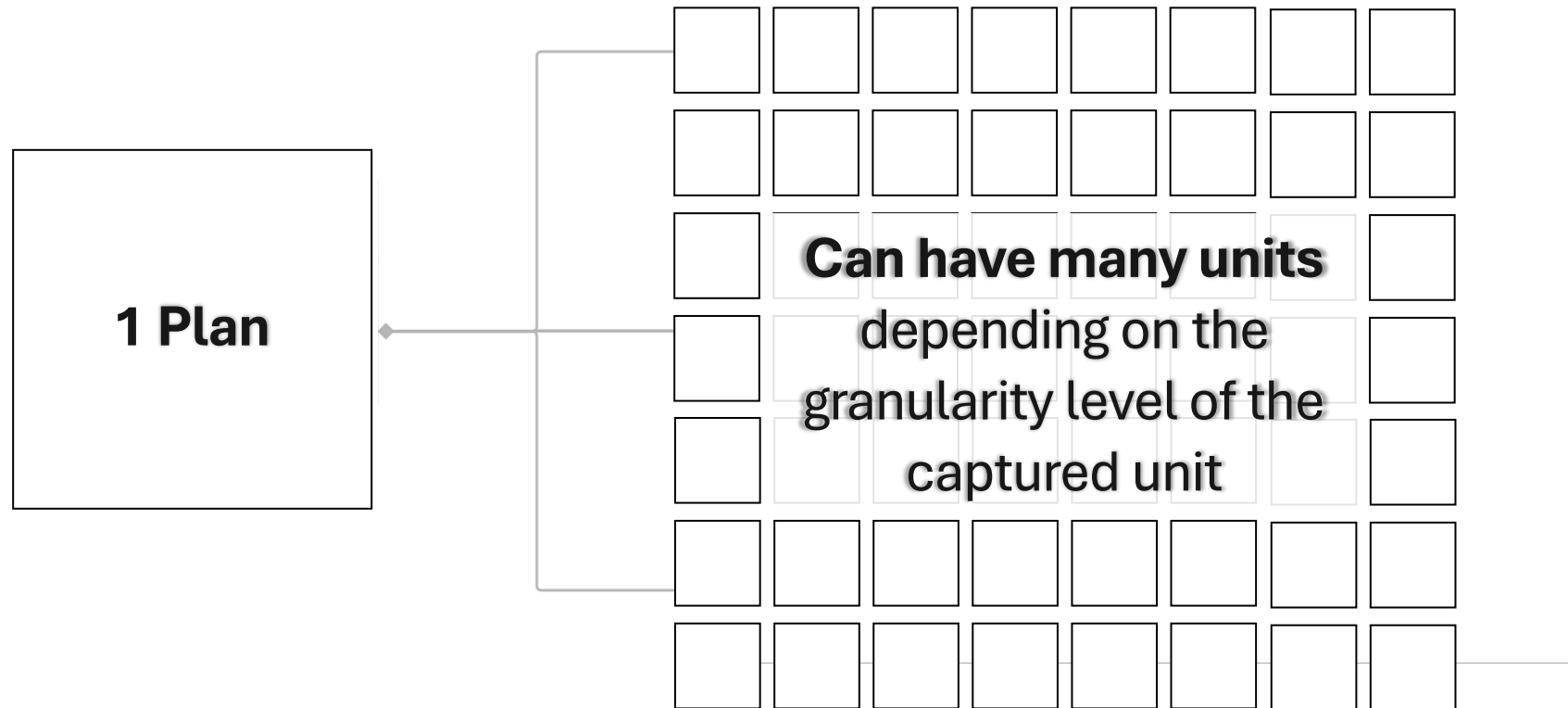
For representing more details
for each specific plan level...



3. Estonia country profile

LADM Part 5 mapping

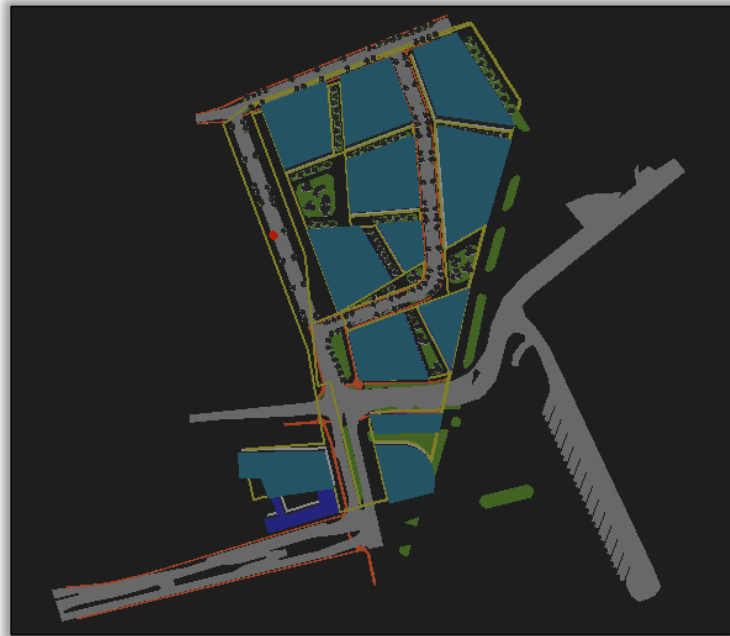
So...



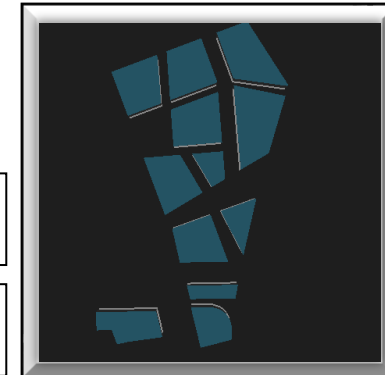
3. Estonia country profile

LADM Part 5 mapping

So, a unit can be

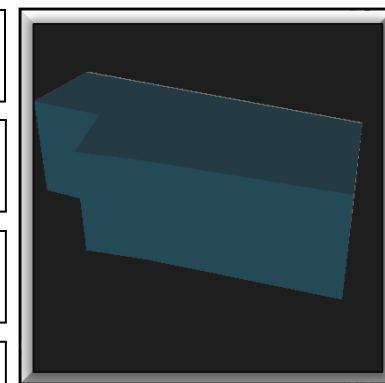


the whole built environment



OR/AND

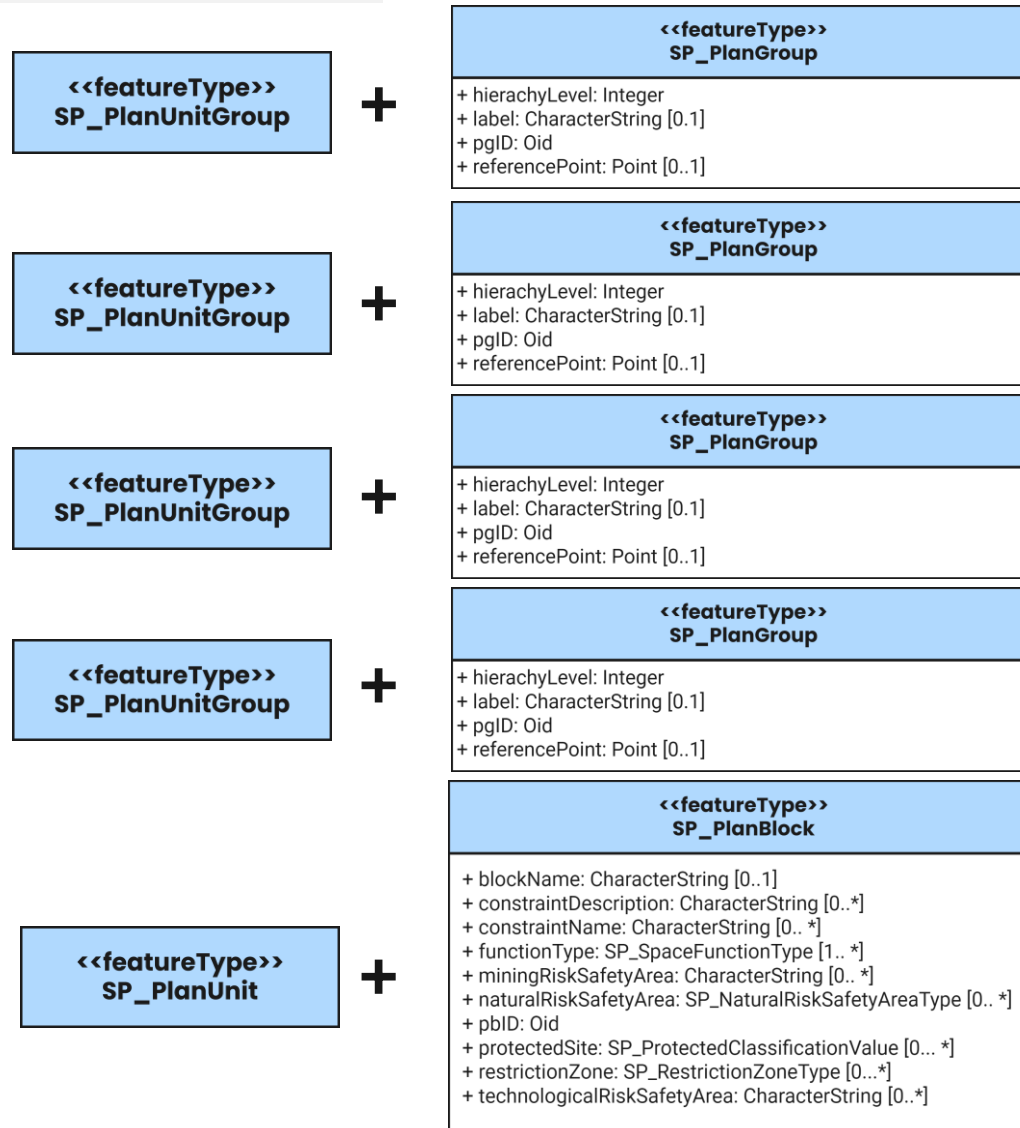
one building



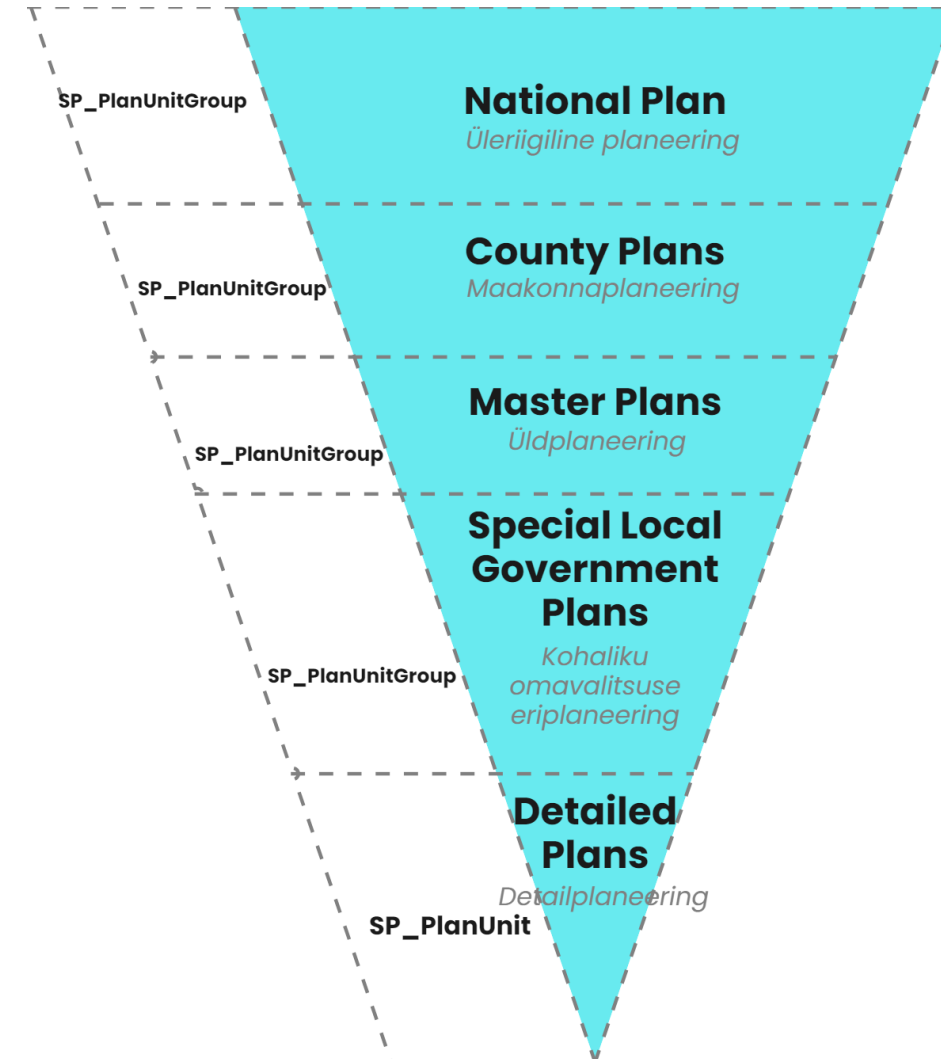
3. Estonia country profile

LADM Part 5 mapping

LADM Classes

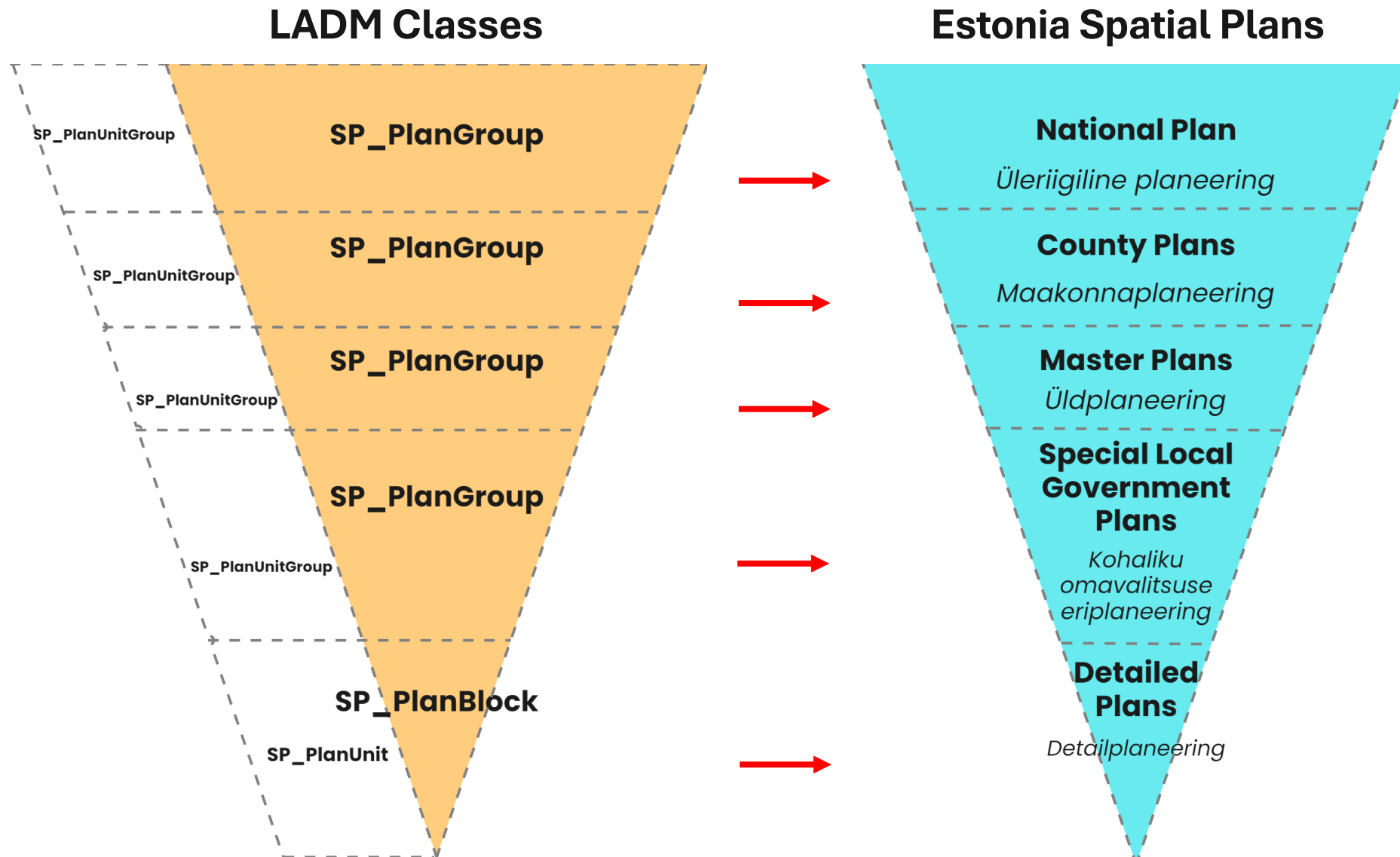


Estonia Spatial Plans



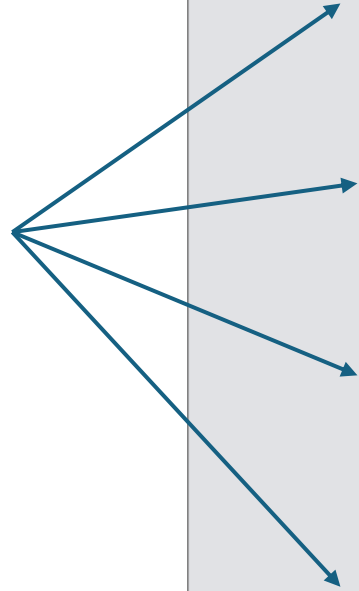
3. Estonia country profile

LADM Part 5 mapping



3. Estonia country profile Metadata and Versioning

Mostly developed
according to the additional
information PLANK offers



PLANK

REGIONAAL- JA PÕLLUMAJANDUSMINISTEERIUM DATA GOT OF PLANEERATIONS

Detail planetary
Field tn 4 land and surrounding detailed planning

General information Files Planetary space data Planetary on map Versions

General information

Purpose : Designation of construction rights to the planning area for the construction of a commercial building with a surface of a building of approx. 1600 m2 and conversion of land to a commercial land.

Organizer reference: <https://antsla.ee/et/algatatud-detailplaneeringud>

Strategic assessment of environmental impact: no

More general planning from the species: no

Procedural information

Date of initiation: 9/22/2021

Date of acceptance: 03.08.2022

Date of establishment: 9/21/2022 [Establishment of a detail plan_Agriculture 4.asice](#)

Date of last version: 9/21/2022 [Establishment of a detail plan_Agriculture 4.asice](#)

Identifiers

Data collection ID: 30100010

Organizer ID:

Land Board ID:

Metadata

planner: Laura Andla

draftsman: Laura Andla, planner

software: Autodesk Autocad LT 2017

data model: 100

chain_coordinate system: L-EST97

chain_correction system: EH2000

jam plan: 1:500

contact: laura@archpro.ee

4. Implementation

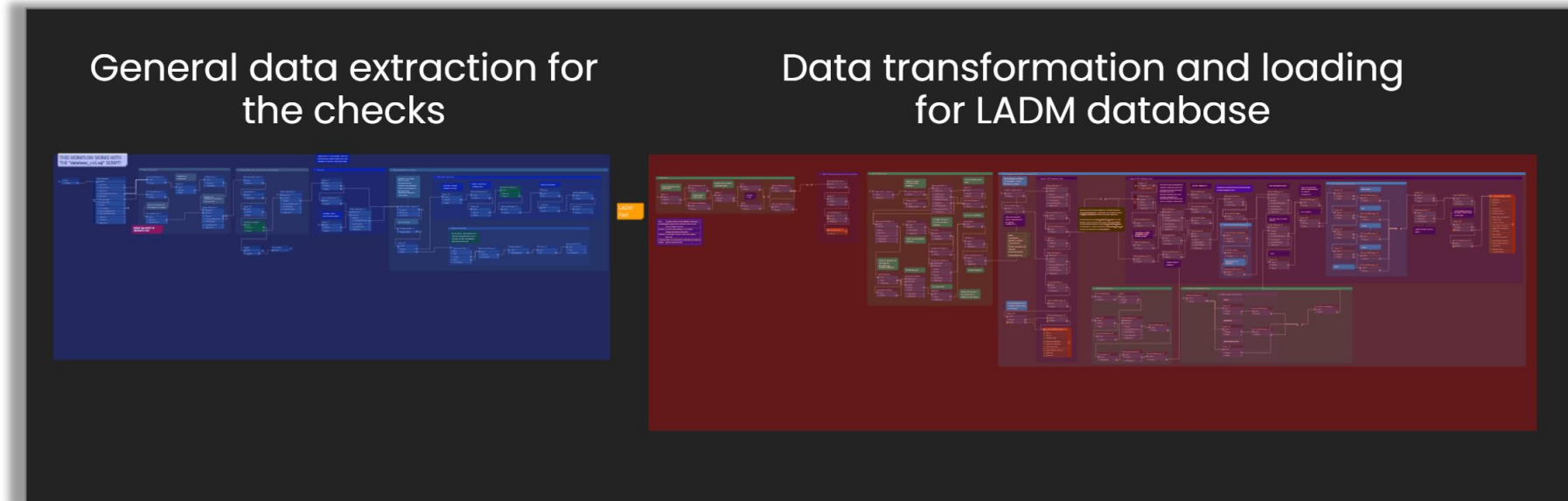
LADM Database Setup

```
00 --
01 -- PostgreSQL database dump
02 --
03 --
04 -- Dumped from database version 16.1
05 -- Dumped by pg_dump version 16.1
06 --
07 SET statement_timeout = 0;
08 SET lock_timeout = 0;
09 SET idle_in_transaction_session_timeout = 0;
10 SET client_encoding = 'UTF8';
11 SET standard_conforming_strings = on;
12 SELECT pg_catalog.set_config('search_path', '', false);
13 SET check_function_bodies = false;
14 SET xmloption = content;
15 SET client_min_messages = warning;
16 SET row_security = off;
17 --
18 -- Name: public; Type: SCHEMA; Schema: -; Owner: -
19 --
20 -- *not* creating schema, since initdb creates it
21 --
22 -- Name: SCHEMA public; Type: COMMENT; Schema: -; Owner: -
23 --
24 COMMENT ON SCHEMA public IS '';
25 --
26 -- Name: postgis; Type: EXTENSION; Schema: -; Owner: -
27 --
28 -- Name: EXTENSION postgis; Type: COMMENT; Schema: -; Owner: -
29 --
30 -- Name: get_triggers(); Type: FUNCTION; Schema: public; Owner: -
```

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

4. Implementation

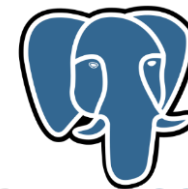
Import Plans to the Database



PLAN data
(IFC)



Mapping IFC attributes to
classes/attributes in LADM database



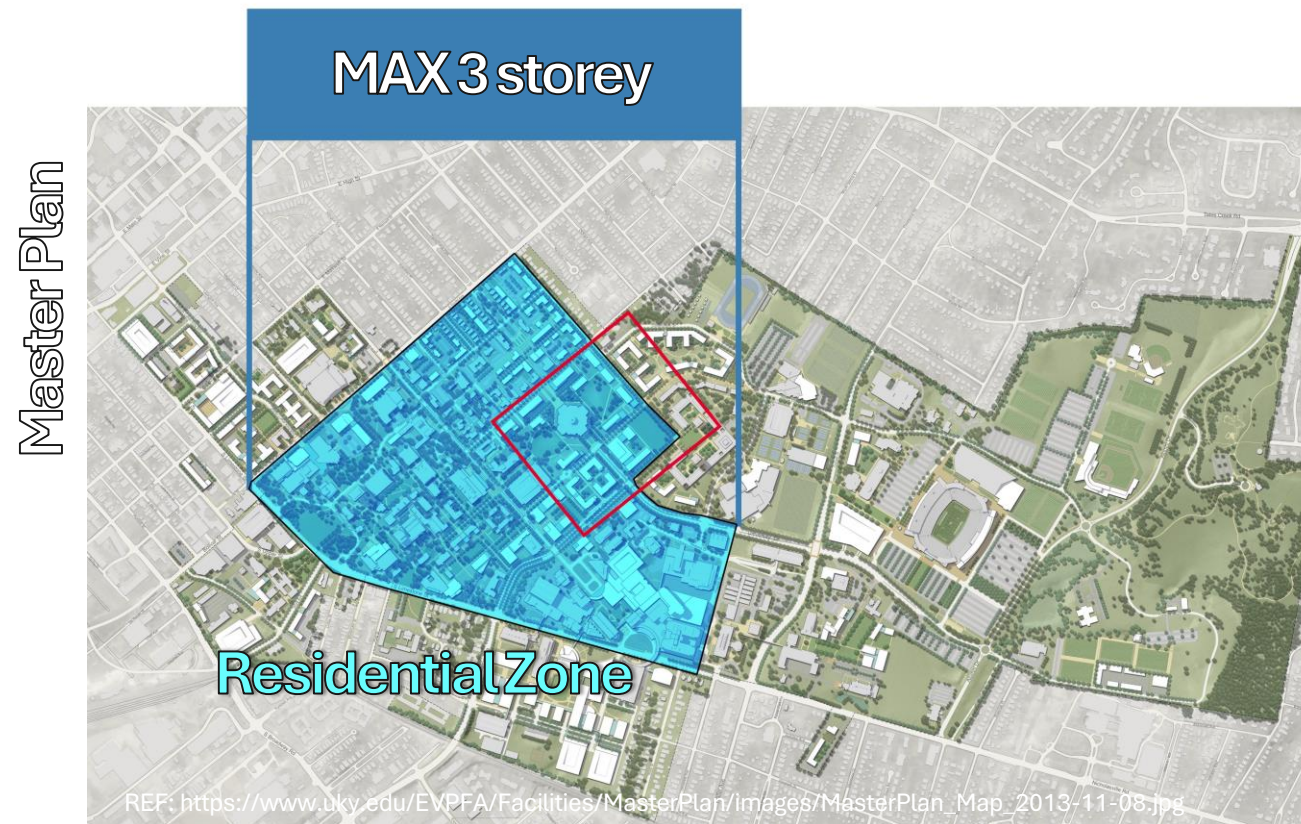
PostgreSQL
LADM P5
Database

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

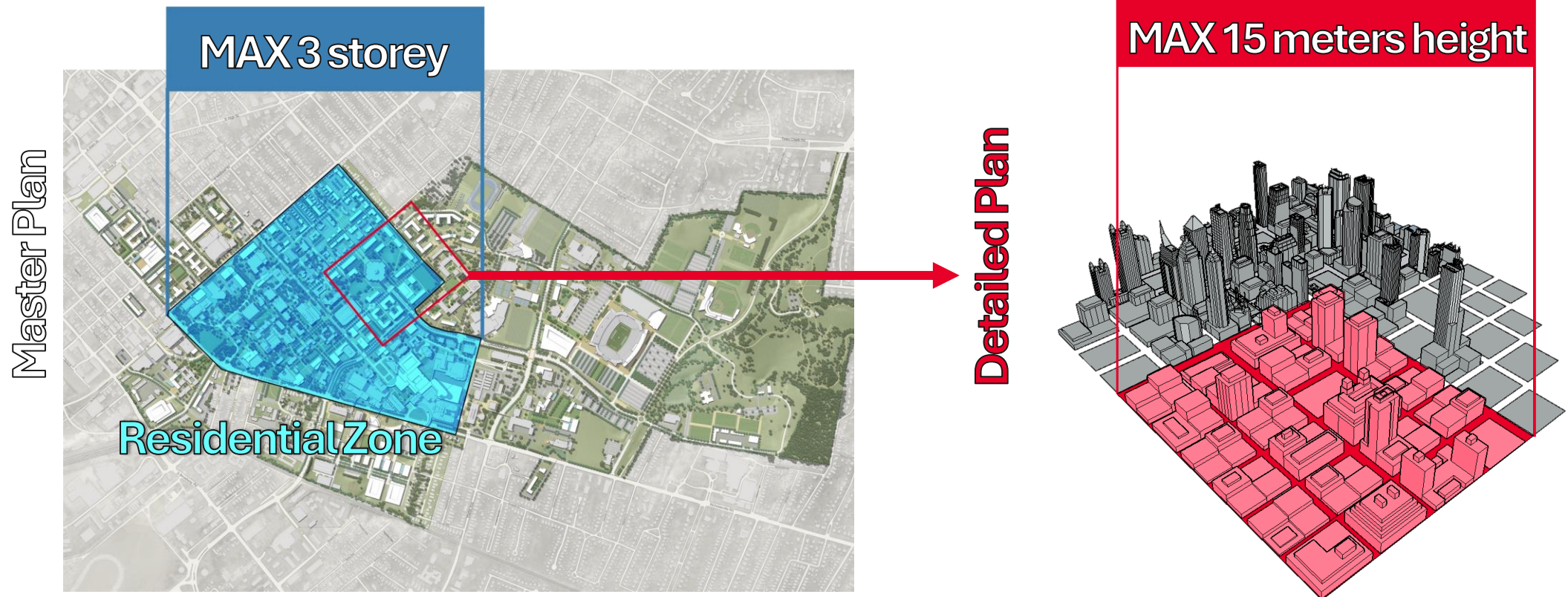


4. Implementation

Compliance Checks: *Example*

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

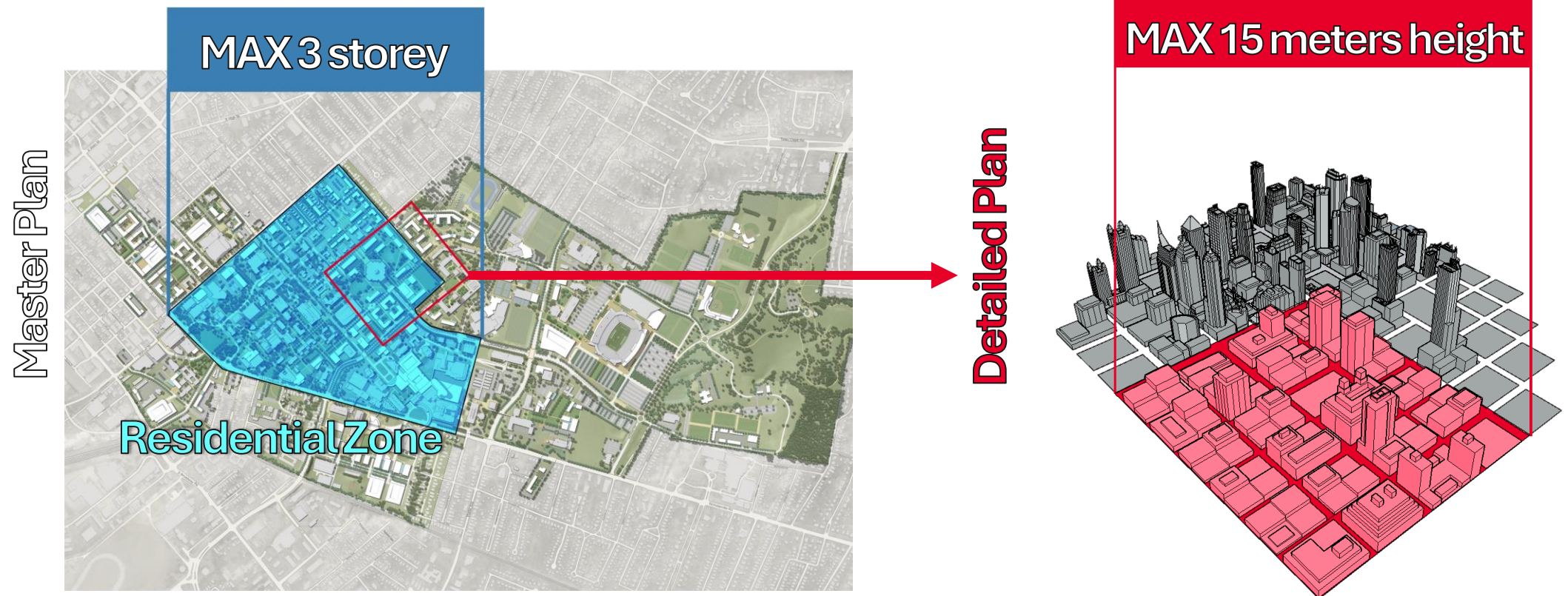
1. Upload an IFC file of the Detailed Plan and access required Master Plan data
2. Check if the model fits the IDS requirements (ensuring that information is in the correct location and format)
3. Compute the checks



4. Implementation

Compliance Checks: *Example*

Does the **Detail Plan** comply against **Master Plan** regulations?

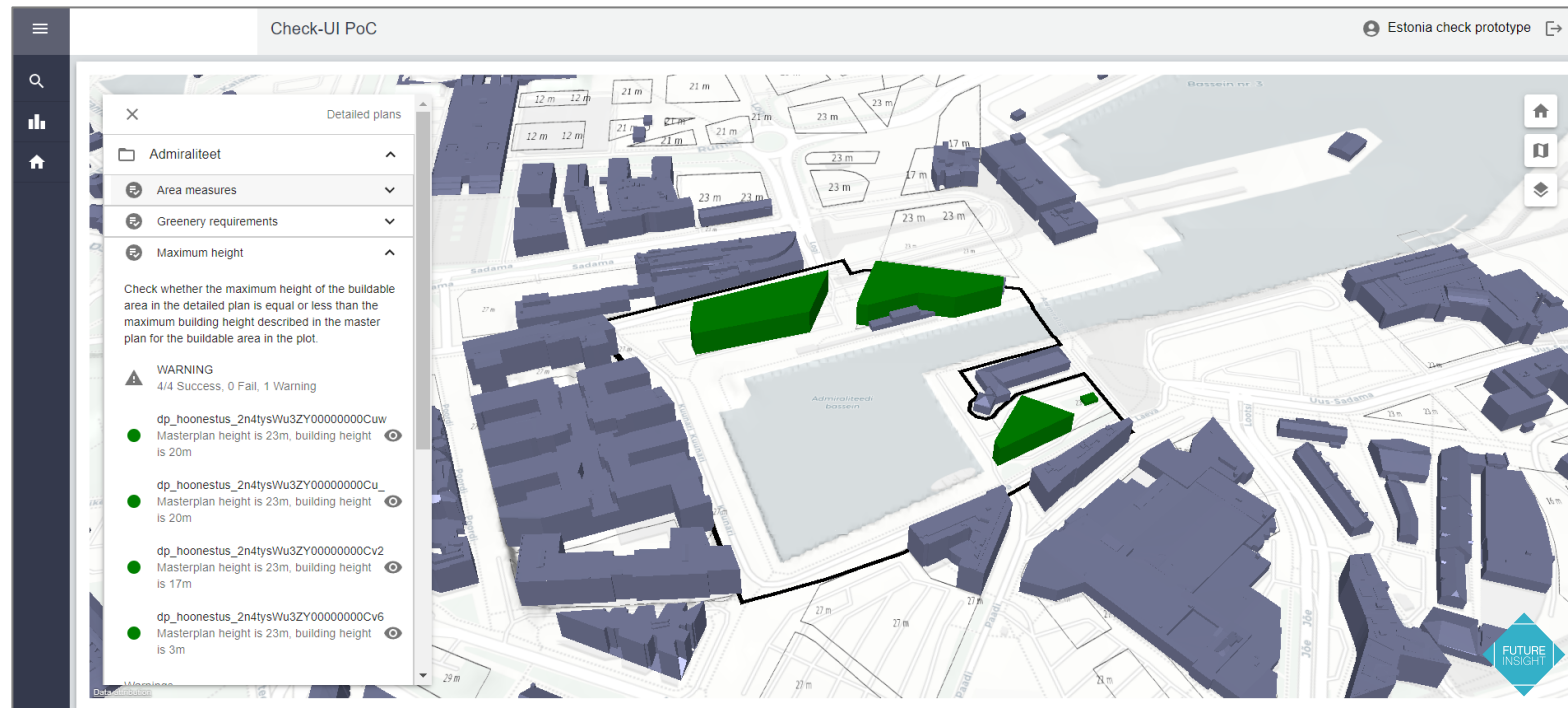


4. Implementation

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*

Check-UI PoC

Estonia check prototype

Detailed plans

- Admiraliteet
- Louna
- Pohi
- Area measures
- Greenery requirements
- Maximum height
- Building distance

Check that calculates whether the buildable area's comply with the minimal distance (8 m) to other buildings from the Digital Twin.

WARNING
9/12 Success, 0 Fail, 3 Warning

- dp_hoonestus_7**
no existing buildings in buffer, closest building is dp_hoonestus_4 with 10.8m distance
- dp_hoonestus_1**
no existing buildings in buffer, closest building is dp_hoonestus_2 with 11.12m distance
- dp_hoonestus_6

FUTURE INSIGHT

4. Implementation

Compliance Checks: *Example*

The screenshot shows a web-based interface titled "Check-UI PoC" for "Estonia check prototype". On the left, a sidebar lists "Detailed plans" including Admiraliteet, Louna, and Pohi, along with various check categories like Area measures, Greenery requirements, Maximum height, and Building distance. The main area displays a 3D architectural model of buildings. A red box highlights a specific building, with four red arrows pointing from text labels to it: "Dataset", "Available Checks", "Description of the check", and "Check results with additional comments on the results". The bottom right corner features a "FUTURE INSIGHT" logo.

Check-UI PoC

Estonia check prototype

Detailed plans

- Admiraliteet
- Louna
- Pohi
- Area measures
- Greenery requirements
- Maximum height
- Building distance

Check that calculates whether the buildable area's comply with the minimal distance (8 m) to other buildings from the Digital Twin.

WARNING
9/12 Success, 0 Fail, 3 Warning

- dp_hoonestus_7
no existing buildings in buffer, closest building is dp_hoonestus_4 with 10.8m distance
- dp_hoonestus_1
no existing buildings in buffer, closest building is dp_hoonestus_2 with 11.12m distance
- dp_hoonestus_6

Dataset

Available Checks

Description of the check

Check results with additional comments on the results

FUTURE INSIGHT

4. Implementation

Compliance Checks: *Example*

Check-UI PoC

Estonia check prototype

Detailed plans

- Points of interest
- Protected area
- Cadastral distance

Check if buildable areas are located in a plot, and calculates the minimum, mean and maximum distance to the plot boundary.

FAIL
1/4 Success, 2 Fail, 1 Warning

- dp_hoonestus_2n4tysWu3ZY00000000Cv2
Buildable area not in a plot
- dp_hoonestus_2n4tysWu3ZY00000000Cv6
Buildable area not in a plot
- dp_hoonestus_2n4tysWu3ZY00000000Cuw
Min. distance is 0, max distance is 13.08, mean distance is 4.79
- dp_hoonestus_2n4tysWu3ZY00000000Cu_
Part of buildable area outside of plot boundary, Min. distance is 0, max distance is 10.36, mean distance is 3.72

Louna

Pohi

FUTURE INSIGHT

4. Implementation

Final Pipeline

1

All plan types
(Master, Detailed plan etc.)



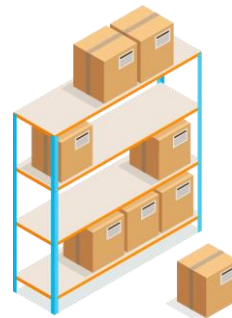
2

Access required
information



3

Store information
through LADM



4

Compute checks



5

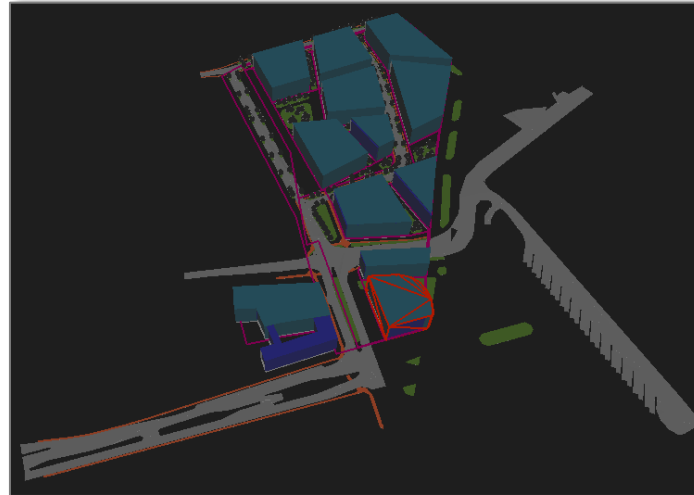
Check results



4. Implementation

Data Read from the Database

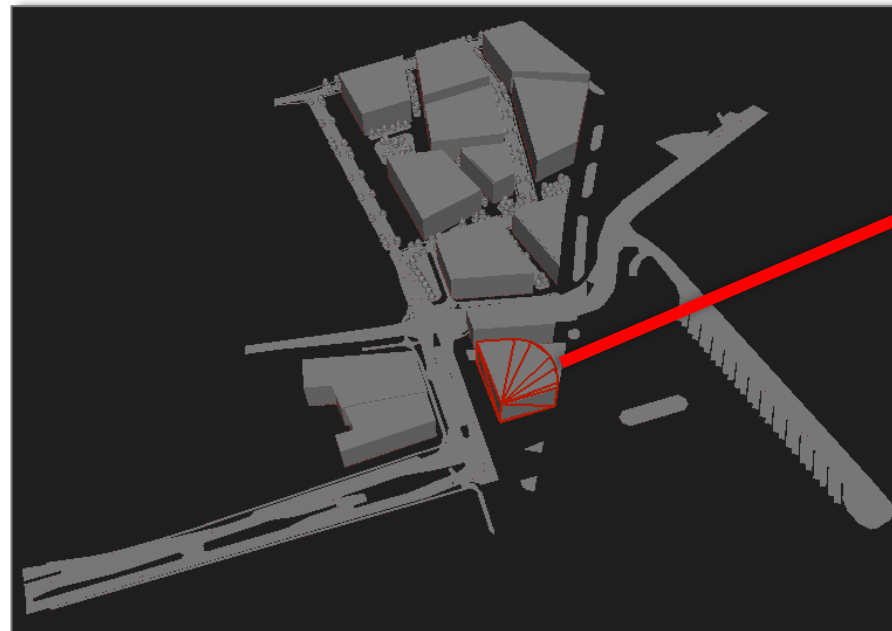
Initial data



Information stored in the DB



Data read from the LADM database



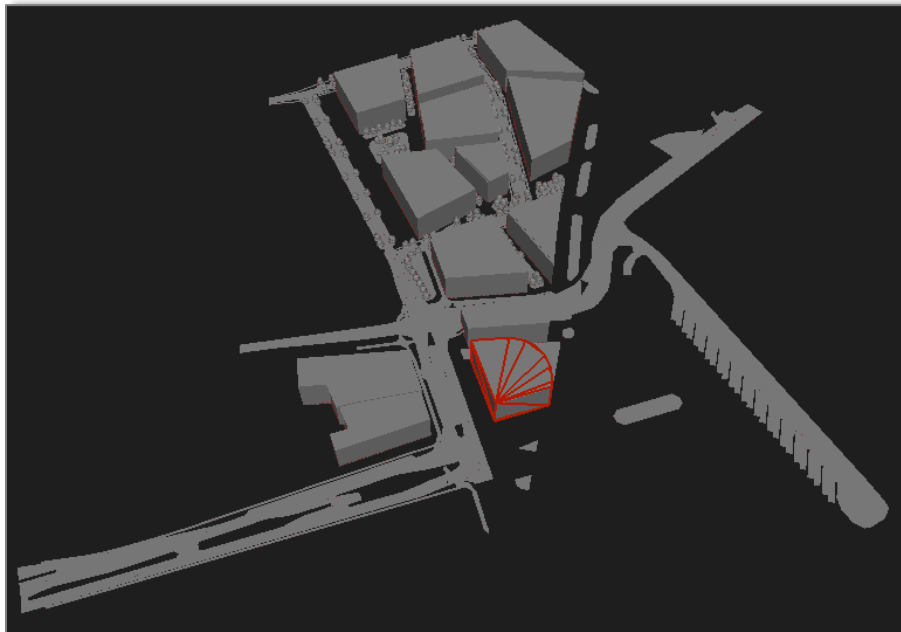
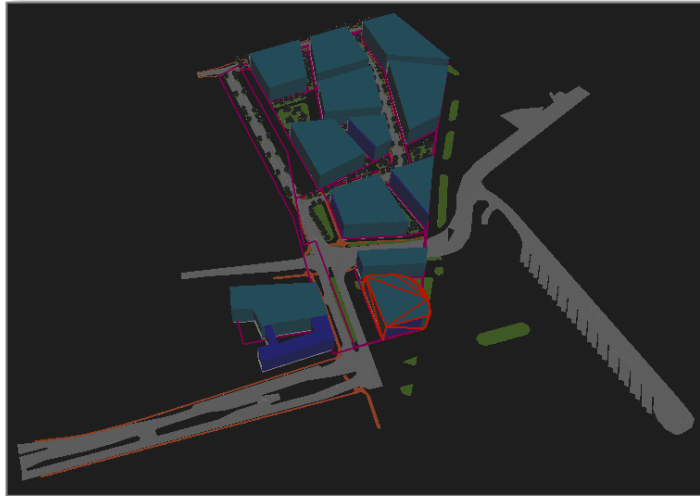
Features Selected: 1 of 1 In: public.est_detailed_unit

Property	Value
sub_function_n...	<null>
sub_function_ty...	<null>
surface_relati...	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	2n4tysWu3ZY0000000CtN
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

```
SP_PlanGroup
<<featureType>>
EST_MasterPlan

+ masterPlanID: Oid [1]
+ name: CharacterString [0..1]
+ organizerReference: URL [0..1]
+ SEIAConducted: Boolean [0..1]
+ modifiesGeneralPlan: Boolean [0..1]
+ planningObjective: CharacterString [0..1]
+ strategicPrincipleAreas: CharacterString [0..1]
+ geometry: Geometry [0..*]

:: SP_PlanGroup
+ hierarchyLevel: Integer
+ label: CharacterString [0..1]
+ landUseType: SP_HigherLevelSpaceFunction [0..*]

:: VersionedObject
+ beginLifespanVersion: Date [0..1] = realWorldTime
+ beginRealWorldLifespanVersion: Date [0..1]
+ beginLifespanLastVersion: Date [0..1]
+ endLifespanVersion: Date [0..1]
+ initiatedDate: Date [0..1]
```

```
SP_PlanUnit
<<featureType>>
EST_DetailedUnit

+ detailedPlanUnitID: Oid [1]
+ detailedPlanID: integer [1]
+ uniqueSourceID: VarChar [1]
+ name: CharacterString [0..1]
+ areaSize: Integer [0..1]
+ description: CharacterString [0..*]
+ floorAboveGround: integer [1]
+ floorBelowGround: integer [1]
+ geometry: Geometry [0..*]
+ discipline: VarChar [1]
+ globalId: VarChar [1]
+ depthBelowGround: integer [1]
+ conditions: VarChar [1]
+ elementType: VarChar [1]

:: SP_PlanUnit
+ currentArea: integer [0..*]
+ currentVolume: integer [0..*]
+ featureProtected: CharacterString [0..*]
+ maxAreaIndications: integer [0..1]
+ maxHeightIndications: integer [0..1]
+ maxVolumeIndications: integer [0..1]
+ otherConstructionIndications: CharacterString [0..*]
+ otherIndications: CharacterString [0..*]
+ 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]

-----
+ computeArea(): Area
+ computeVolume(): Volume

:: VersionedObject
+ beginLifespanVersion: Date [0..1] = realWorldTime
+ beginRealWorldLifespanVersion: Date [0..1]
+ beginLifespanLastVersion: Date [0..1]
+ endLifespanVersion: Date [0..1]
+ initiatedDate: Date [0..1]
```

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

```
1 WITH latest_versions AS (  
2   SELECT  
3     dp.detailed_plan_id,  
4     dp.name AS plan_name,  
5     dp.begin_lifespan_version,  
6     dp.end_lifespan_version,  
7     dp.master_plan_id,  
8     ROW_NUMBER() OVER (  
9       PARTITION BY dp.detailed_plan_id  
10      ORDER BY dp.begin_lifespan_version DESC  
11     ) AS version_order  
12  FROM  
13    est_detailed_plan dp  
14  WHERE  
15    dp.detailed_plan_id = '101' -- Example plan ID for comparison  
16    AND dp.begin_lifespan_version = dp.begin_lifespan_lastversion -- Identifies the most recent version  
17 )  
18 SELECT  
19   lv.detailed_plan_id AS detailedPlanID,  
20   lv.plan_name,  
21   lv.begin_lifespan_version AS plan_start_date,  
22   lv.end_lifespan_version AS plan_end_date,  
23   SUM(CASE WHEN du.discipline = 'dp_haljastus' THEN du.current_area ELSE 0 END) AS greenery_area,  
24   SUM(CASE WHEN du.discipline = 'plan_ala' THEN du.current_area ELSE 0 END) AS plot_area,  
25   ROUND(  
26     SUM(CASE WHEN du.discipline = 'dp_haljastus' THEN du.current_area ELSE 0 END) /  
27     SUM(CASE WHEN du.discipline = 'plan_ala' THEN du.current_area ELSE 0 END) * 100, 2  
28   ) AS greenery_percentage,  
29   mp.strategic_principle_areas AS master_plan_requirement  
30  FROM  
31    latest_versions lv  
32  JOIN  
33    est_detailed_unit du ON lv.detailed_plan_id = du.detailed_plan_id  
34  JOIN  
35    est_master_plan mp ON lv.master_plan_id = mp.master_plan_id  
36  WHERE  
37    lv.version_order <= 2 -- Select the last two versions based on lifespan versioning  
38    AND mp.strategic_principle_areas ILIKE '%min 30% greenery for an area of 5000 square meters%'  
39  GROUP BY  
40    lv.detailed_plan_id, lv.plan_name, lv.begin_lifespan_version,  
41    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.

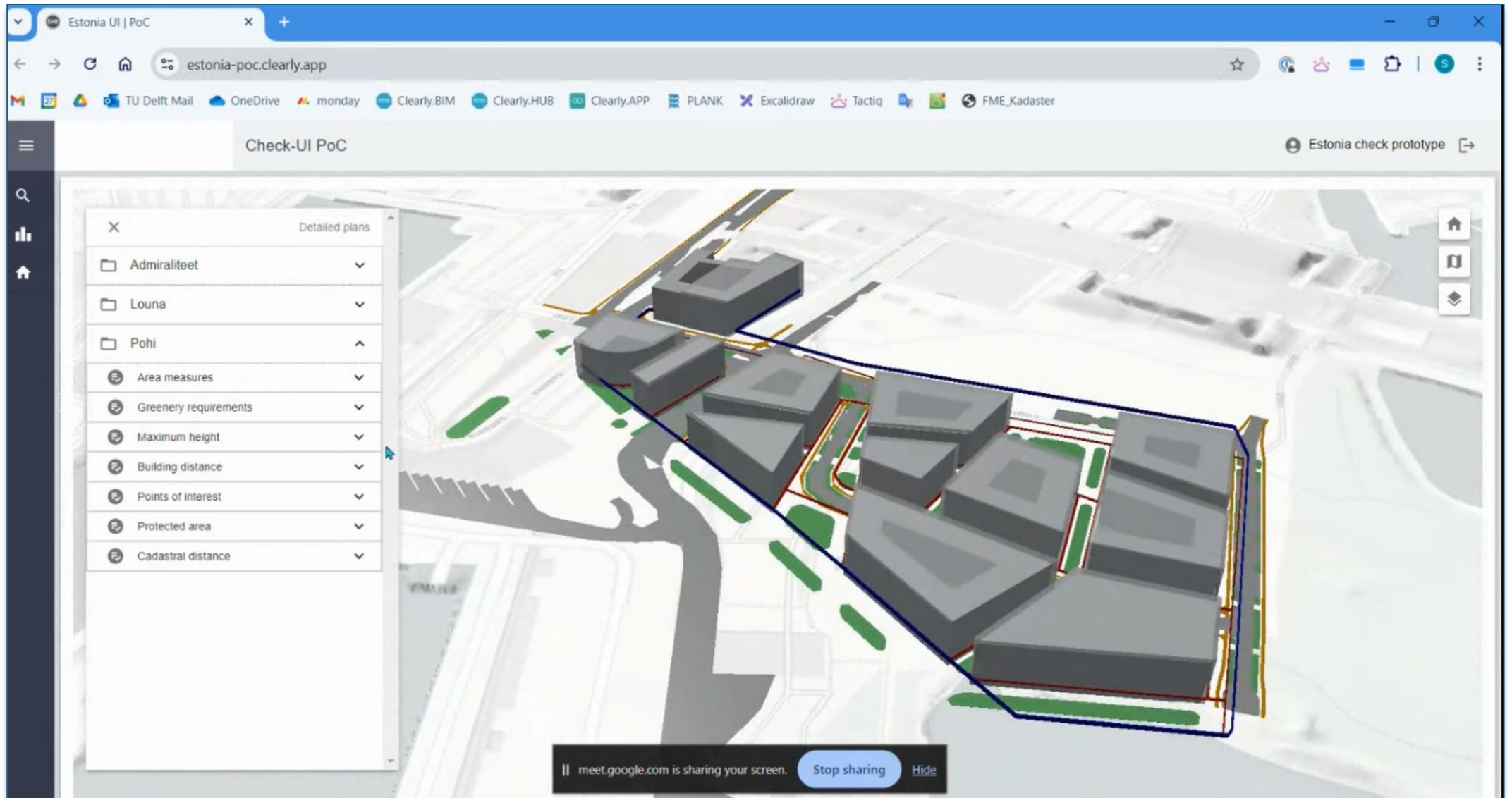
Example output of the query

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	<i>min 30% greenery for an area of 5000 square meters</i>
101	Central Park	2024-04-01	2024-06-30	1400	5000	28.00	<i>min 30% greenery for an area of 5000 square meter</i>

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

The screenshot shows the pgAdmin 4 interface. On the left, the Object Explorer shows a tree view of database objects, with 'est_detailed_unit' selected under 'Tables (32)'. The main window displays a SQL query:

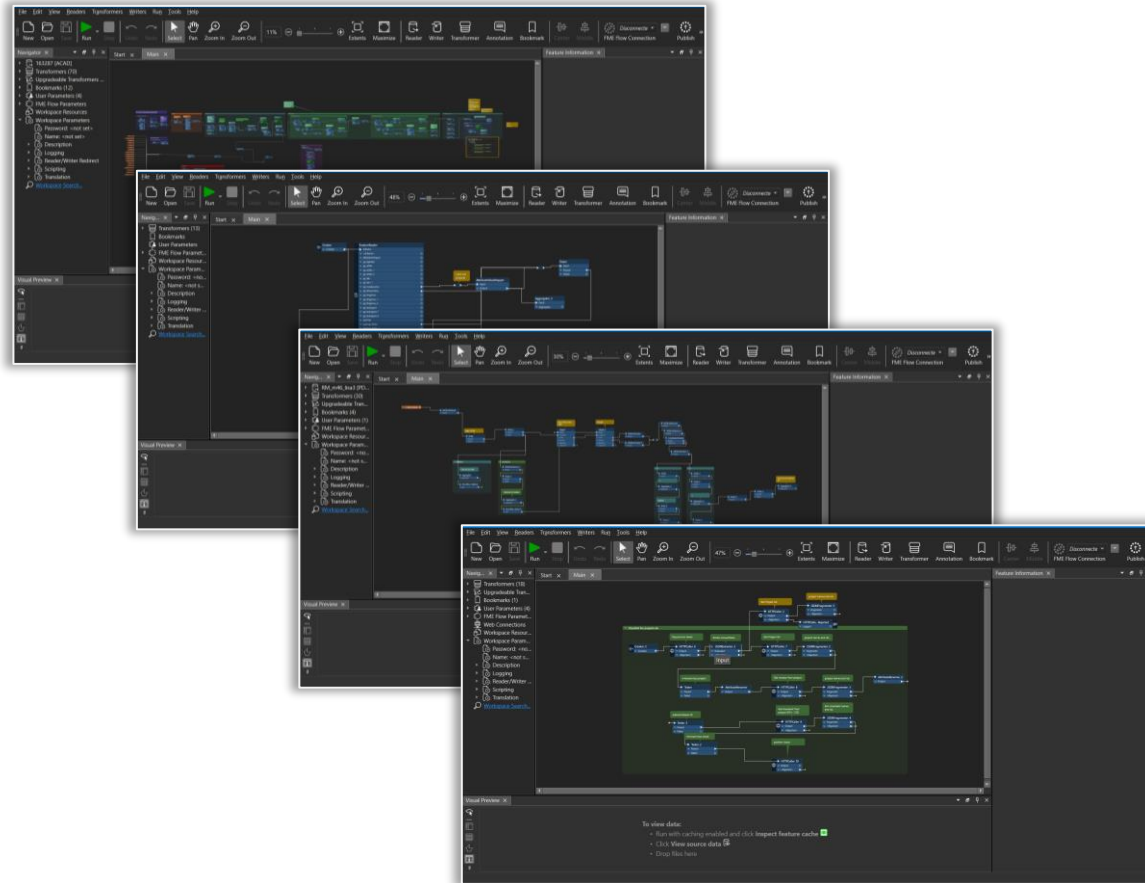
```
1 SELECT * FROM public.est_detailed_unit
2 ORDER BY detailed_plan_unit_id ASC
```

Below the query editor, the 'Data Output' tab shows a table with the following columns and data:

	geometry	detailed_plan_unit_id	detailed_plan_id	plan_id	name	feature_protected	max_area_indications	max_height_indications
	geometry	[PK] integer	character varying (255)	character varying	text	text[]	integer	integer
19	010F0000A0E50C...	19	1	210011	NoName1	[null]	[null]	[null]
20	010F0000A0E50C...	20	1	210011	NoName1	[null]	[null]	[null]
21	010F0000A0E50C...	21	1	210011	NoName1	[null]	[null]	[null]
22	010F0000A0E50C...	22	1	210011	NoName1	[null]	[null]	[null]
23	010F0000A0E50C...	23	1	210011	NoName1	[null]	[null]	[null]
24	010F0000A0E50C...	24	1	210011	NoName1	[null]	[null]	[null]
25	010F0000A0E50C...	25	1	210011	NoName1	[null]	[null]	[null]
26	010F0000A0E50C...	26	1	210011	NoName1	[null]	[null]	[null]
27	010F0000A0E50C...	27	1	210011	NoName1	[null]	[null]	[null]
28	010F0000A0E50C...	28	1	210011	NoName1	[null]	[null]	[null]
29	01070000A0E50C...	29	1	210011	NoName1	[null]	[null]	[null]

A status bar at the bottom indicates 'Total rows: 29 of 29' and 'Waiting for the query to complete... 00:00:00.023'. A watermark '- Waiting for the query to complete...' is visible over the table data.

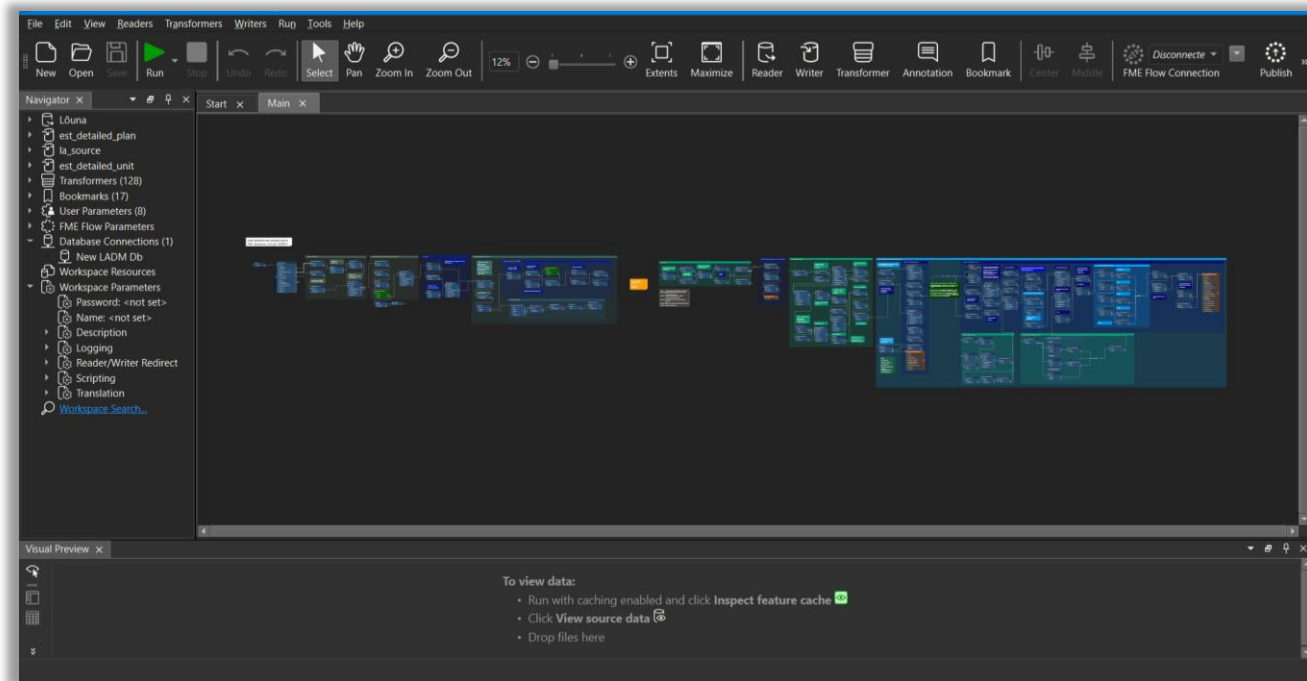
5. Conclusion and Future Research



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

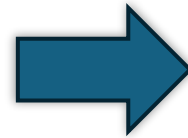
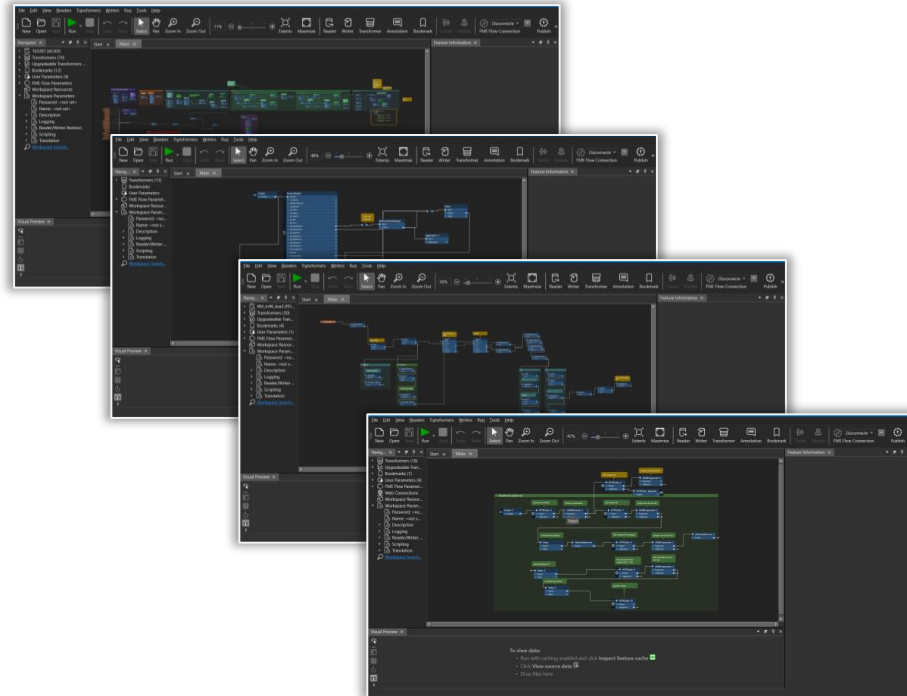
The screenshot shows a PostgreSQL query editor interface. The query is: `SELECT * FROM public.est_detailed_unit ORDER BY detailed_plan_unit_id ASC`. The results are displayed in a table with the following columns: geometry, detailed_plan_unit_id, detailed_plan_id, plan_id, name, current_area, current_volume, discipline, and begin_lifespan_vers. The table contains 17 rows of data.

geometry	detailed_plan_unit_id	detailed_plan_id	plan_id	name	current_area	current_volume	discipline	begin_lifespan_vers
010F0000A0E50C...	1	1	210011	NoName1	3382	74398	dp_hoone	2024-09-29
010F0000A0E50C...	2	1	210011	NoName1	2771	43807	dp_hoone	2024-09-29
010F0000A0E50C...	3	1	210011	NoName1	2789	48260	dp_hoone	2024-09-29
010F0000A0E50C...	4	1	210011	NoName1	1562	34375	dp_hoone	2024-09-29
010F0000A0E50C...	5	1	210011	NoName1	2601	46012	dp_hoone	2024-09-29
010F0000A0E50C...	6	1	210011	NoName1	968	21300	dp_hoone	2024-09-29
010F0000A0E50C...	7	1	210011	NoName1	3825	63451	dp_hoone	2024-09-29
010F0000A0E50C...	8	1	210011	NoName1	1334	29353	dp_hoone	2024-09-29
010F0000A0E50C...	9	1	210011	NoName1	2638	46511	dp_hoone	2024-09-29
010F0000A0E50C...	10	1	210011	NoName1	877	19298	dp_hoone	2024-09-29
010F0000A0E50C...	11	1	210011	NoName1	1063	23383	dp_hoone	2024-09-29
010F0000A0E50C...	12	1	210011	NoName1	3574	53217	dp_hoone	2024-09-29
010F0000A0E50C...	13	1	210011	NoName1	3614	86742	dp_hoonestus	2024-09-29
010F0000A0E50C...	14	1	210011	NoName1	2919	70059	dp_hoonestus	2024-09-29
010F0000A0E50C...	15	1	210011	NoName1	3134	75210	dp_hoonestus	2024-09-29

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

The screenshot shows a software interface with a tree view on the left and a visual preview on the right. The tree view shows a hierarchy of folders and files, including 'New LADM Db', 'Transformers DB', 'Database Connect...', and 'Workspace Param...'. The visual preview shows a table of data with columns for 'Name', 'Description', 'Logging', 'Reader/Writer', and 'Scripting'. A blue arrow points from the 'est_detailed_unit' table in the top screenshot to the 'Workspace Param...' folder in this screenshot.

5. Conclusion and Future Research

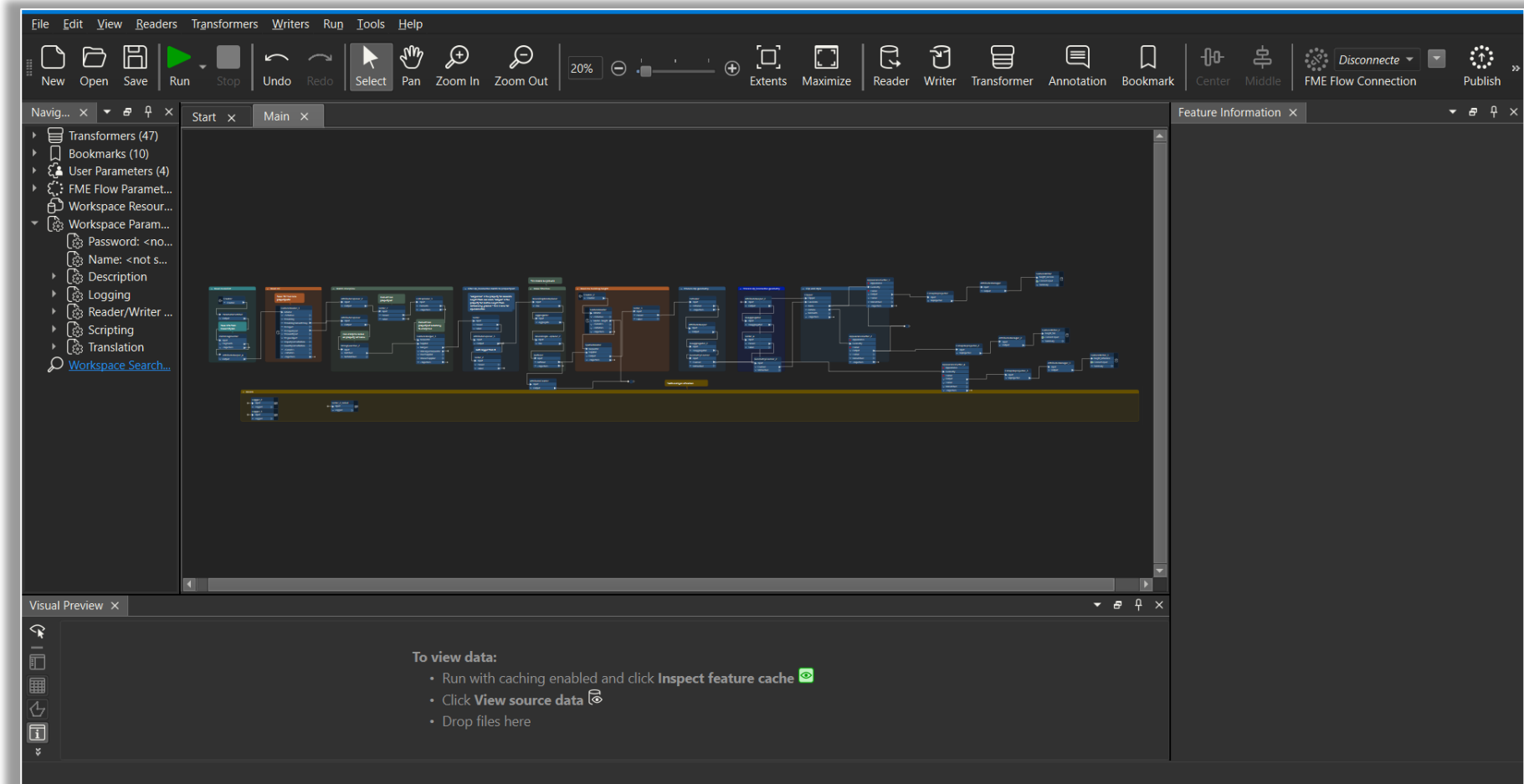


The screenshot shows a database management system interface. On the left, a tree view displays a list of tables, including 'public.est_detailled_unit'. The main window shows a query: `SELECT * FROM public.est_detailled_unit ORDER BY detailed_plan_unit_id ASC`. Below the query, a table displays the results of the query. The table has columns for 'detailed_plan_unit_id', 'plan_id', 'name', 'current_area', 'current_volume', 'discipline', and 'begin_lifespan_wen'. The data is sorted by 'detailed_plan_unit_id' in ascending order.

detailed_plan_unit_id	plan_id	name	current_area	current_volume	discipline	begin_lifespan_wen
1	010F0000AES0C...	NoName1	3382	74798	dp_hoone	2024-09-29
2	010F0000AES0C...	NoName1	2771	42807	dp_hoone	2024-09-29
3	010F0000AES0C...	NoName1	2789	48260	dp_hoone	2024-09-29
4	010F0000AES0C...	NoName1	1562	34375	dp_hoone	2024-09-29
5	010F0000AES0C...	NoName1	2601	46012	dp_hoone	2024-09-29
6	010F0000AES0C...	NoName1	968	21300	dp_hoone	2024-09-29
7	010F0000AES0C...	NoName1	3825	63451	dp_hoone	2024-09-29

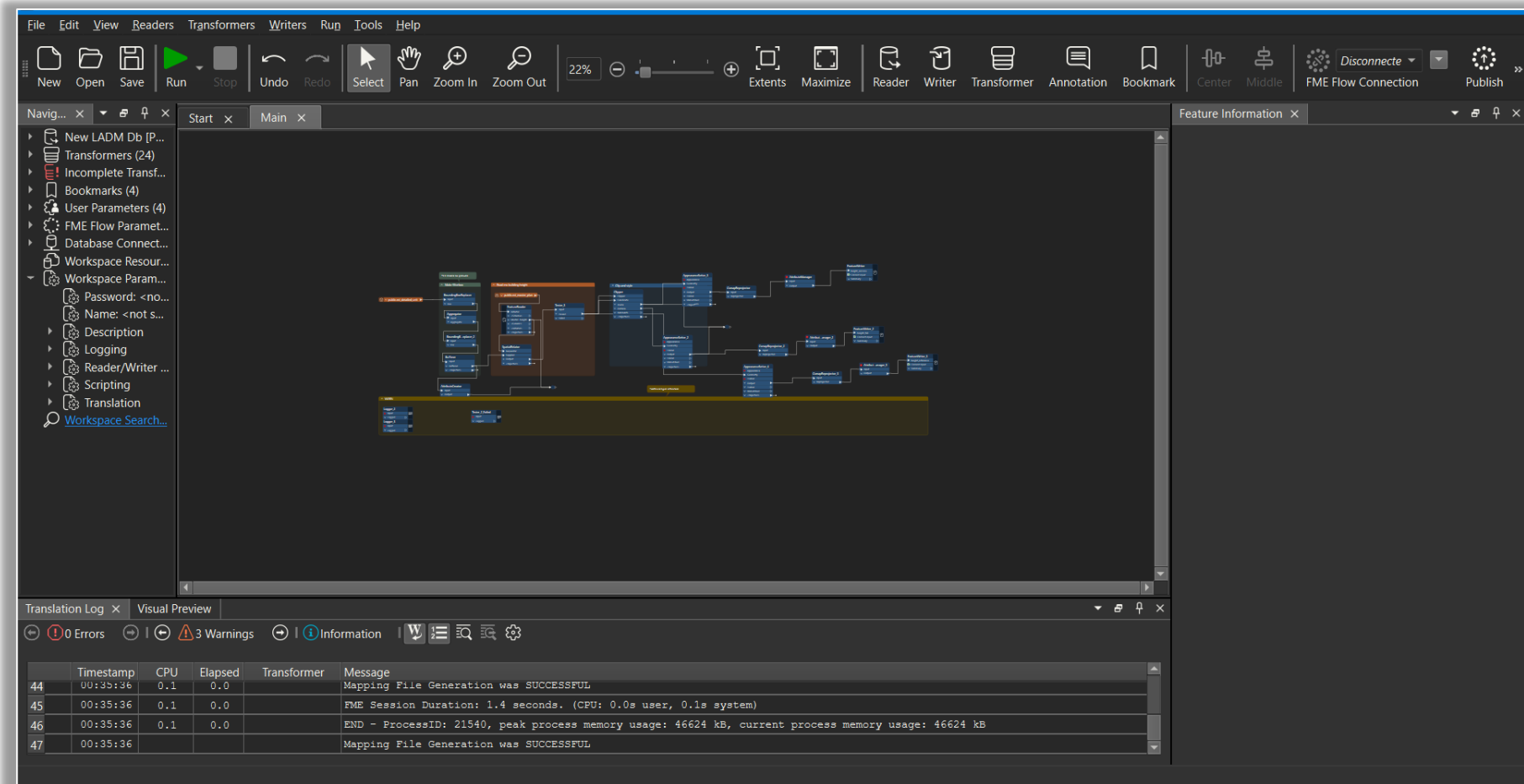
5. Conclusion and Future Research

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:

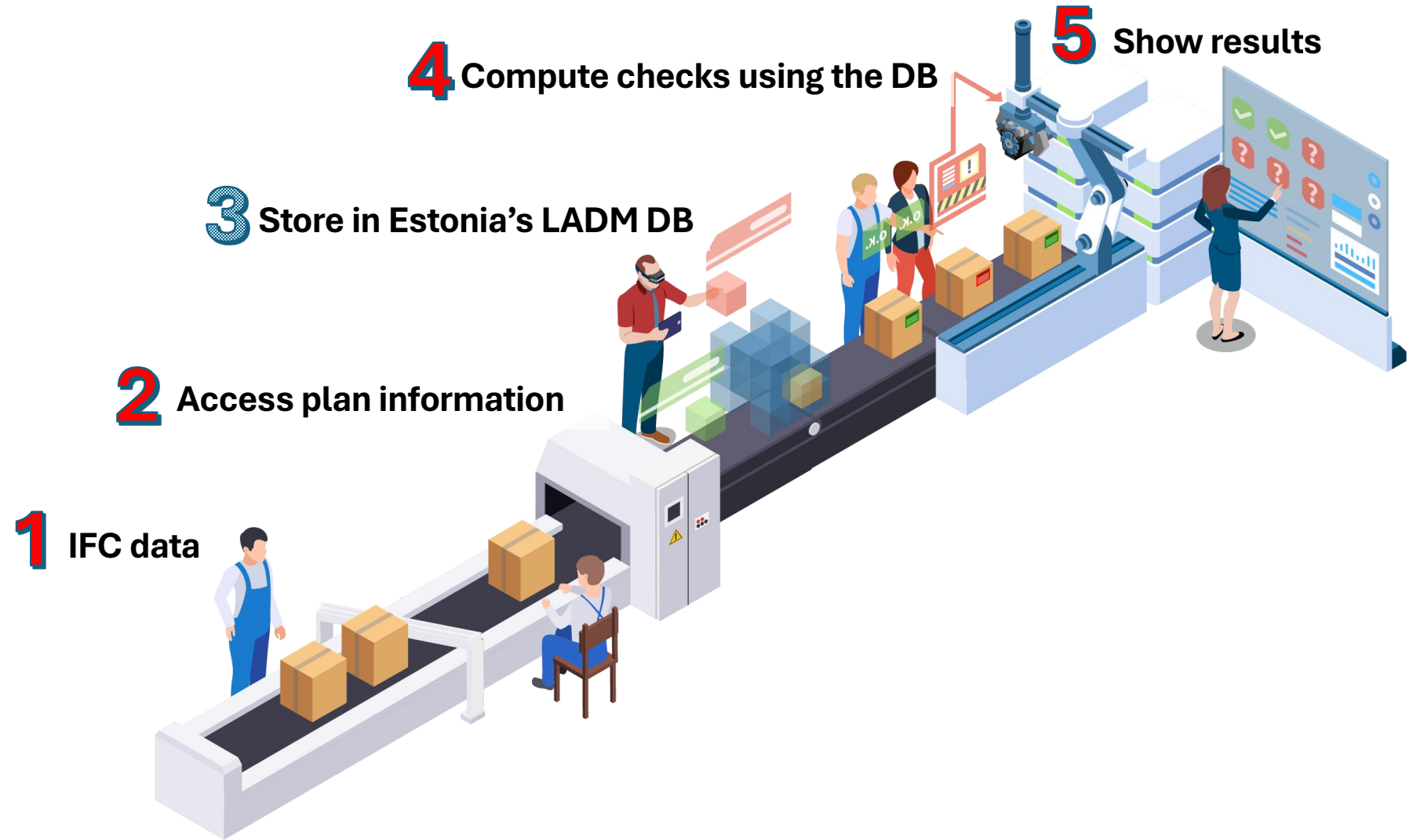


The screenshot displays the FME Desktop software interface. The main workspace shows a workflow diagram with several transformers connected in a sequence. The transformers include a Reader, a Database Connector, and multiple Writer transformers. The interface also features a navigation pane on the left, a status bar at the bottom, and a log table.

Timestamp	CPU	Elapsed	Transformer	Message
00:35:36	0.1	0.0		Mapping File Generation was SUCCESSFUL
00:35:36	0.1	0.0		FME Session Duration: 1.4 seconds. (CPU: 0.0s user, 0.1s system)
00:35:36	0.1	0.0		END - ProcessID: 21540, peak process memory usage: 46624 kB, current process memory usage: 46624 kB
00:35:36				Mapping File Generation was SUCCESSFUL

5. Conclusion and Future Research

Final Pipeline

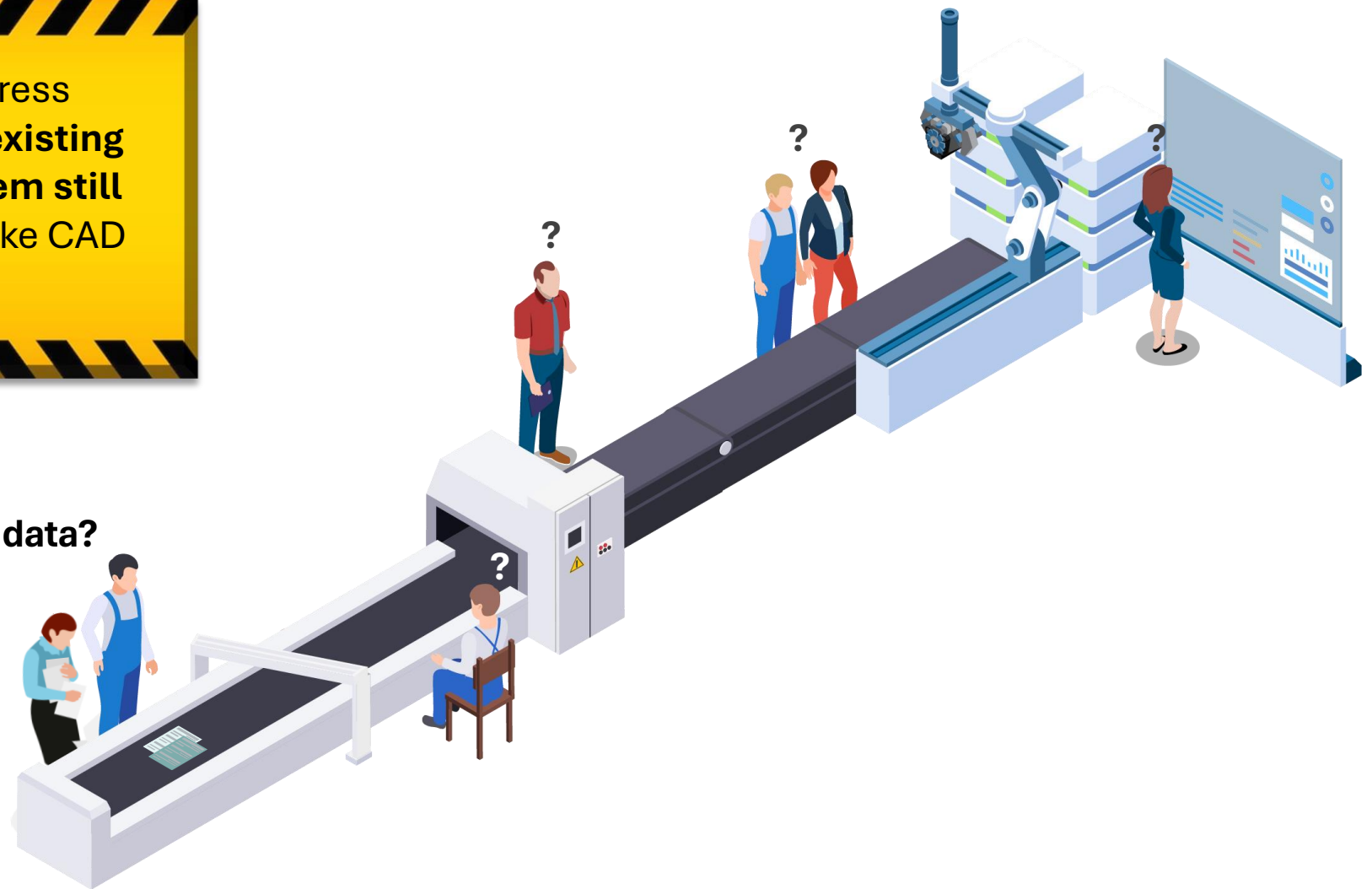


5. Conclusion and Future Research

Investigation of existing 2D data

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

2D data?



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 screenshot shows the PLANK web application interface. The browser address bar displays 'planeeringud.ee/plank-web/#/planning'. The page header includes the logo of the 'REGIONAAL- JA PÖLLUMAJANDUSMINISTEERIUM' and the title 'DATA GOT OF PLANEERATIONS'. A search bar is present with the text 'Planetary name / Data collection ID / Plan ID / Kov ID' and 'Local government / Address / Catastritus'. Below the search bar, there are filters for 'Type of planning' (with a dropdown menu open showing options like 'Detail planetary', 'Special planning of local govern...', 'County planning', 'State special planning', and 'General plan'), 'Condition' (with options 'valid' and 'partially valid'), and 'Period of performance'. A search button labeled 'I'm looking' and an 'Empty filters' button are also visible. The main content area contains a welcome message and information about the PLANK data collection. The footer includes user support contact information and the version number '1.73.0'.

Welcome to use the established planning data collection

The State Planning Data Collection (PLANK) collects and maintains all established plans, regardless of the type of planning. The data collection allows quick access to plan files and data directly through application or services.

The data collection application allows you to find planings in the area of interest, download files, or view plan solution data directly on the map. The instructions for using the data collection can be found here: [PLANK instructions](#)

User support:
611 3076
support@e-construction.ee
E-T 13.00-16.00
K-N 9.00-12.00

Version: 1.73.0

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"

REGIONAAL- JA PÕLLUMAJANDUSMINISTEERIUM

PLANNING DATABASE

Accessibility I'm inside

Search

Card

Control

Detailed planning

Detailed plan of the land area of Põllu tn 4 and the surrounding area

Compilation organizer: Antsla Municipal Gover...

Condition: **valid**

General information Files Spatial data of the planning solution Planning on the map Versions

General information

Purpose : Assigning a building right to the planning area for the construction of a commercial building with an area of approx. 1,600 m2 and changing the purpose of the land to commercial land.

Organizer reference: <https://antsla.ee/et/algatatud-detailplaneeringud>

Strategic Environmental Impact Assessment: no

Changing a rather more general layout: no

User support: 611 3076 tugi@e-ehitus.ee E-N 9:00-16:00

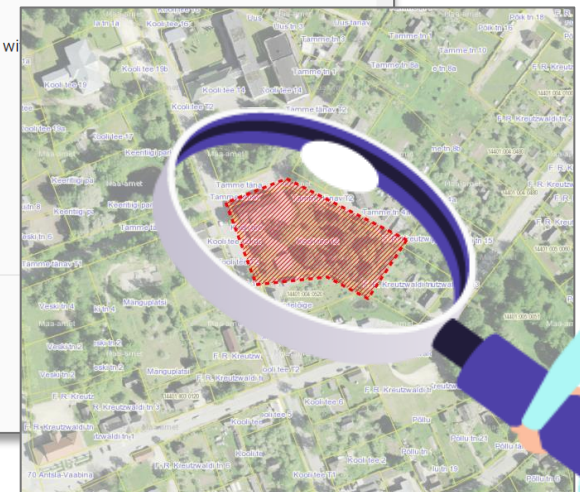
Version: 1.79.0

Procedural information

Date of Initiation: 22.09.2021

Date of receipt: 03.08.2022












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	Pöllu_tn_4_DP Explanation letter_09-09-2022.pdf
 	Representations of drawings (2)	
	JN100 Basic drawing, complete solution, land use plan	Pöllu_tn_4_DP_4_Main drawing_22-07-2022.pdf
	JN220 Technical networks, technical networks	Pöllu_tn_4_DP_5_Technovörgud_06-07-2022.pdf
  	Digital Layers (3)	
	DK402 Metadata table	Pöllu-tn-4_DP_metaandmed_18.10.2022.xlsx
	DK401 Smart data table	Pöllu tn 4_DP_star data_table_19.10.2022.xlsx
	DK202 Planning solution containing spatial data (dwg)	Pöllu_tn_4_DP_digital_layers_19.10.2022.dwg
	Legal basis (1)	
	H0101 Enforcement decision	Establishment of detailed planning_Field 4.asice
	Digitally signed plan (1)	
	DD100 Digitally signed plan	Pöllu_tn_4_DP_09-09-2022.asice
    	Extras (6)	
	UU603 Contact zone analysis	Pöllu_tn_4_DP_3_Kontaktvönd_29-03-2022.pdf
	ML105 Situation diagram	Pöllu_tn_4_DP_1_Situation scheme_29-03-2022.pdf
	UU602 Analysis of the existing situation	Pöllu_tn_4_DP_2_Olemasoleb-ulokord_18-07-2022.pdf
	RI100 Spatial illustrations	Pöllu_tn_4_DP_6_Illustration_18-07-2022.pdf
	MD101 Procedural Documents Folder	Pöllu_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



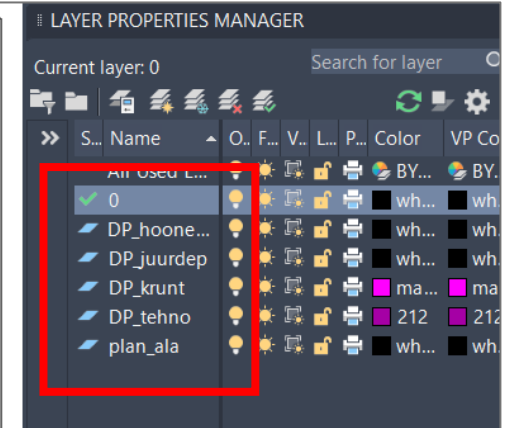
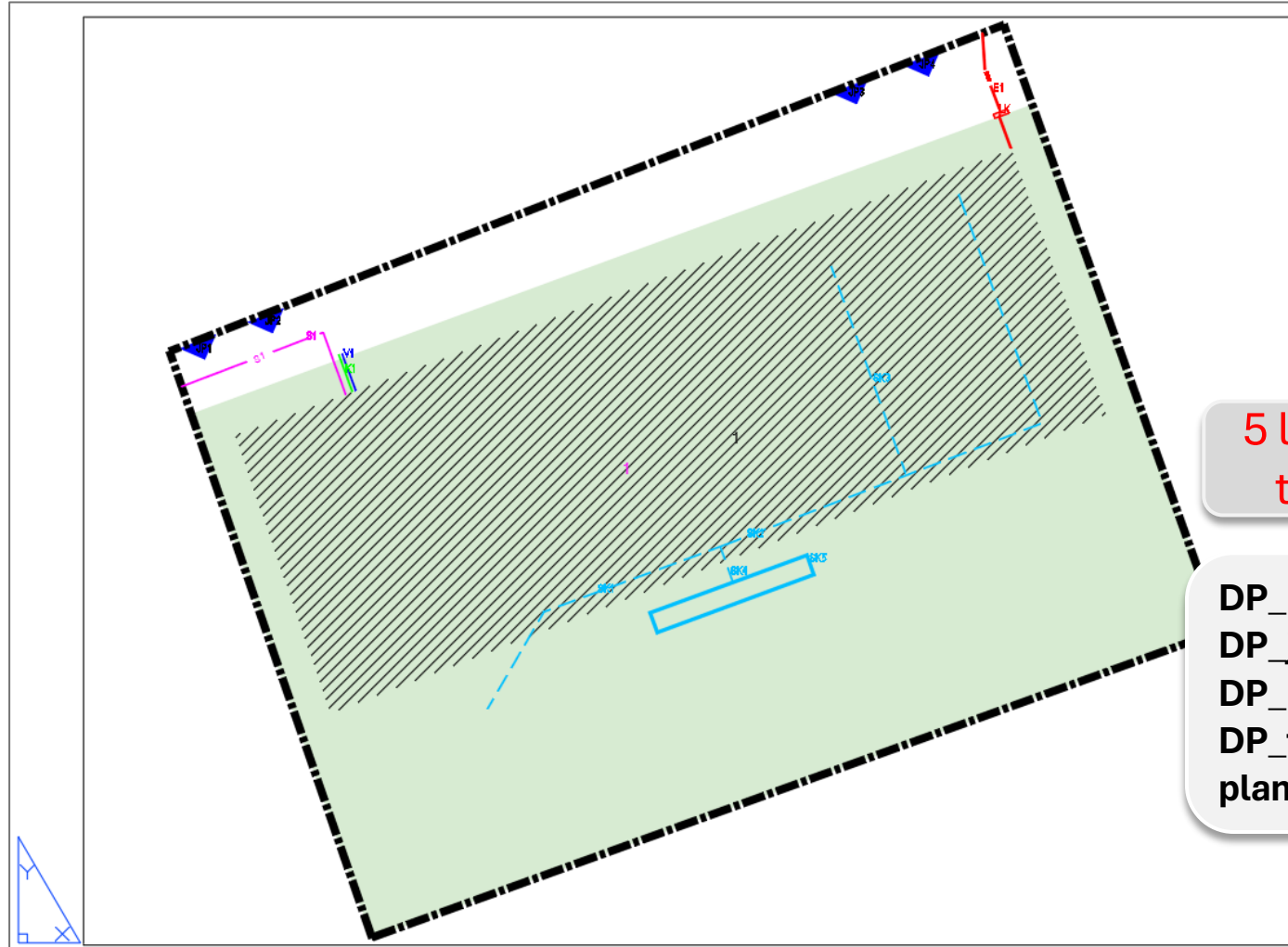
DK401 Smart data table

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

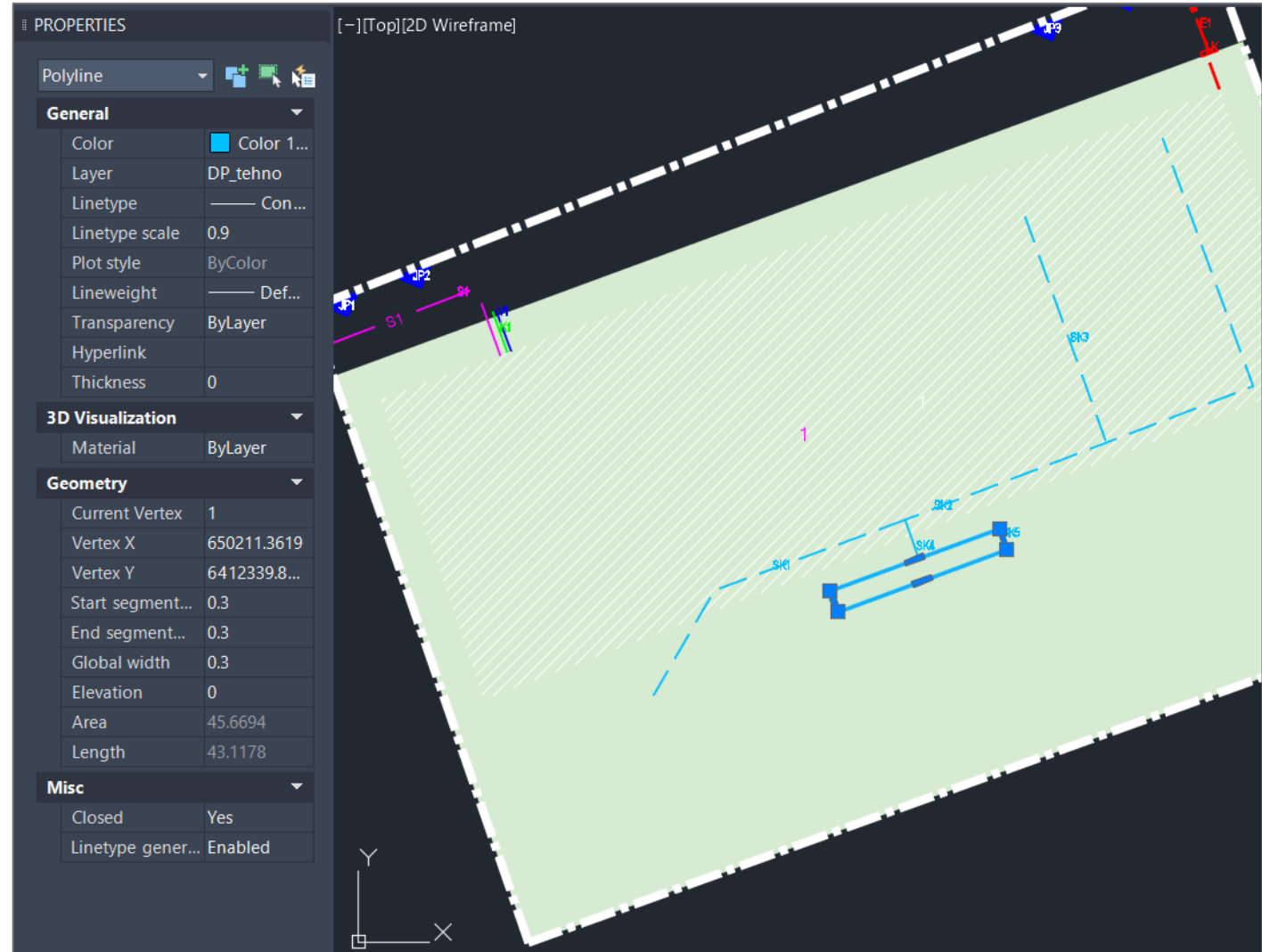
5. Conclusion and Future Research

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
---------	----------	---------------	-------------	-------------------	---------------	-------	---------

Metadata

planner: Laura Andla

compiled by: Laura Andla, planner

software: Autodesk Autocad LT 2017

data model: 100

key_coordination system: L-EST97

keht_korgussystem: EH2000

scale: 1:500

contact: laura@arhpro.ee

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

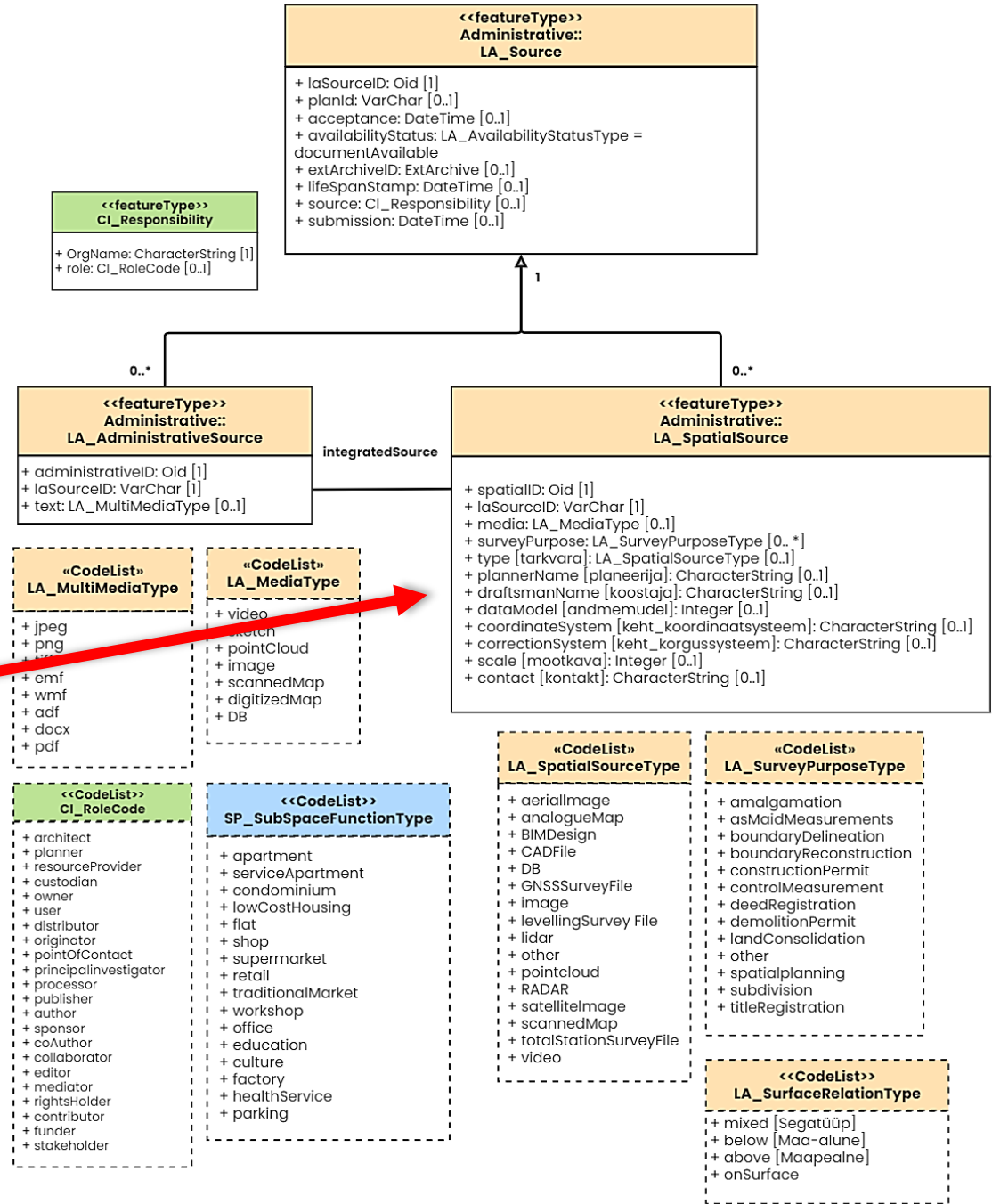
5. Conclusion and Future Research

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

	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_krundisihotstarve | **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).
- **ehTyyp**: 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.

	A	B
1	planNim	planLiik
2	Põllu tn 4 maa-ala	30
3		

plan_ala

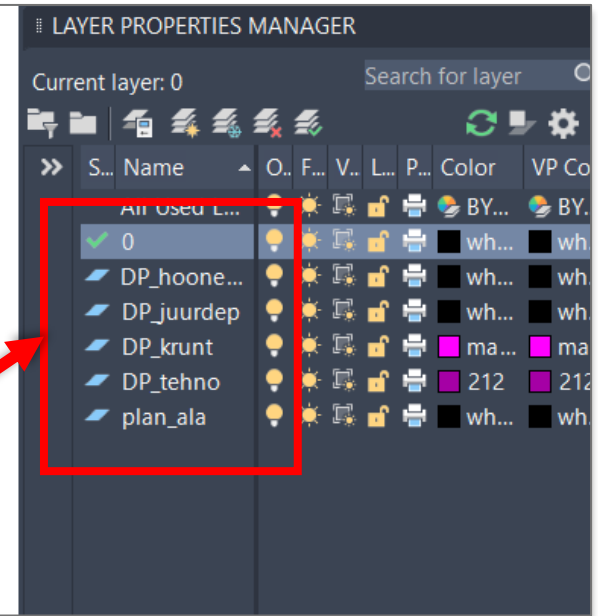
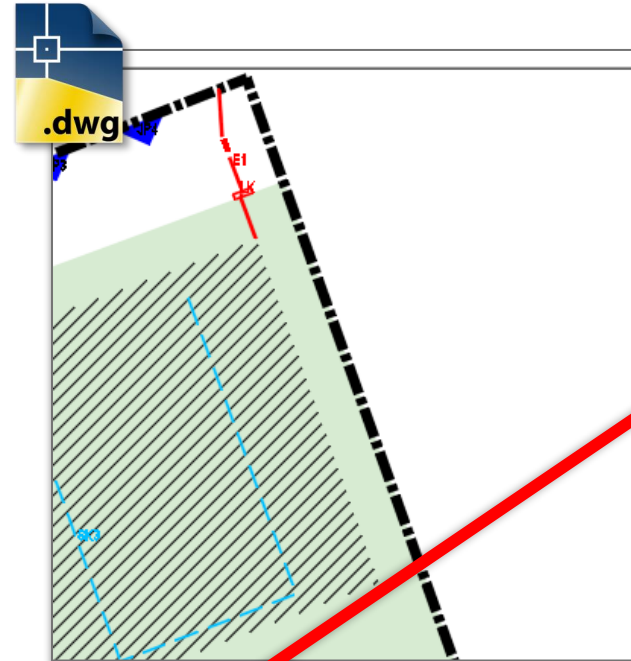
	I	J
vKp	kehtestKp	kehtestNr
/2022	21/09/2022	2-3/347

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_krundisihotstarve | 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

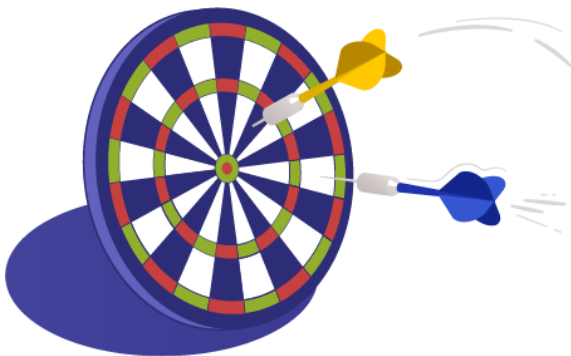
Investigation of existing 2D data



- **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.



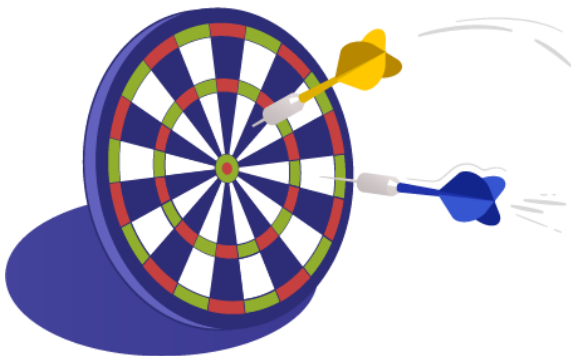
5. Conclusion and Future Research

- 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>