

Leveraging BIM/IFC for the Registration of Spatial Plans and Compliance Checks and Permitting in Estonia based on LADM Part 5 - Spatial Plan Information

Simay BATUM

TU Delft, NETHERLANDS

Eftychia KALOGIANNI

TU Delft, NETHERLANDS

Marjan BROEKHUIZEN

Future Insight, NETHERLANDS

Christopher RAITVIIR

Tallinn University of Technology, ESTONIA

Kermo MÄGI

Ministry of Finance, ESTONIA

Peter VAN OOSTEROM

TU Delft, NETHERLANDS

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

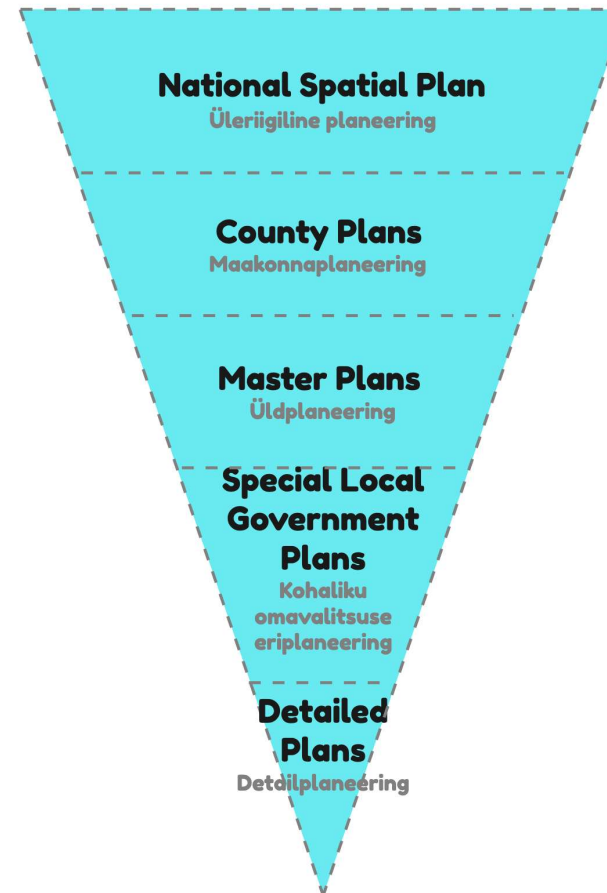
Cadastral Distance check
SUCCESS!



Contents

1. Introduction
2. Country Profile of Estonia
3. Implementation
4. Conclusion and Future Research

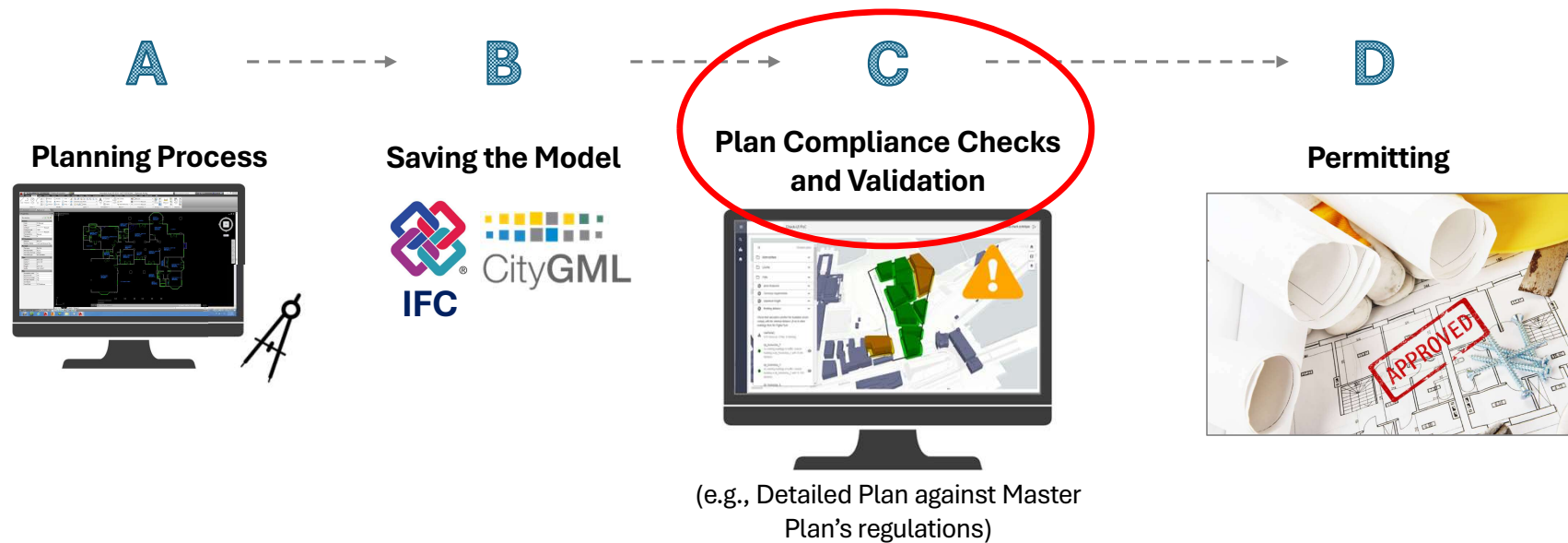
Estonia Hierarchical Spatial Plans



1. Introduction

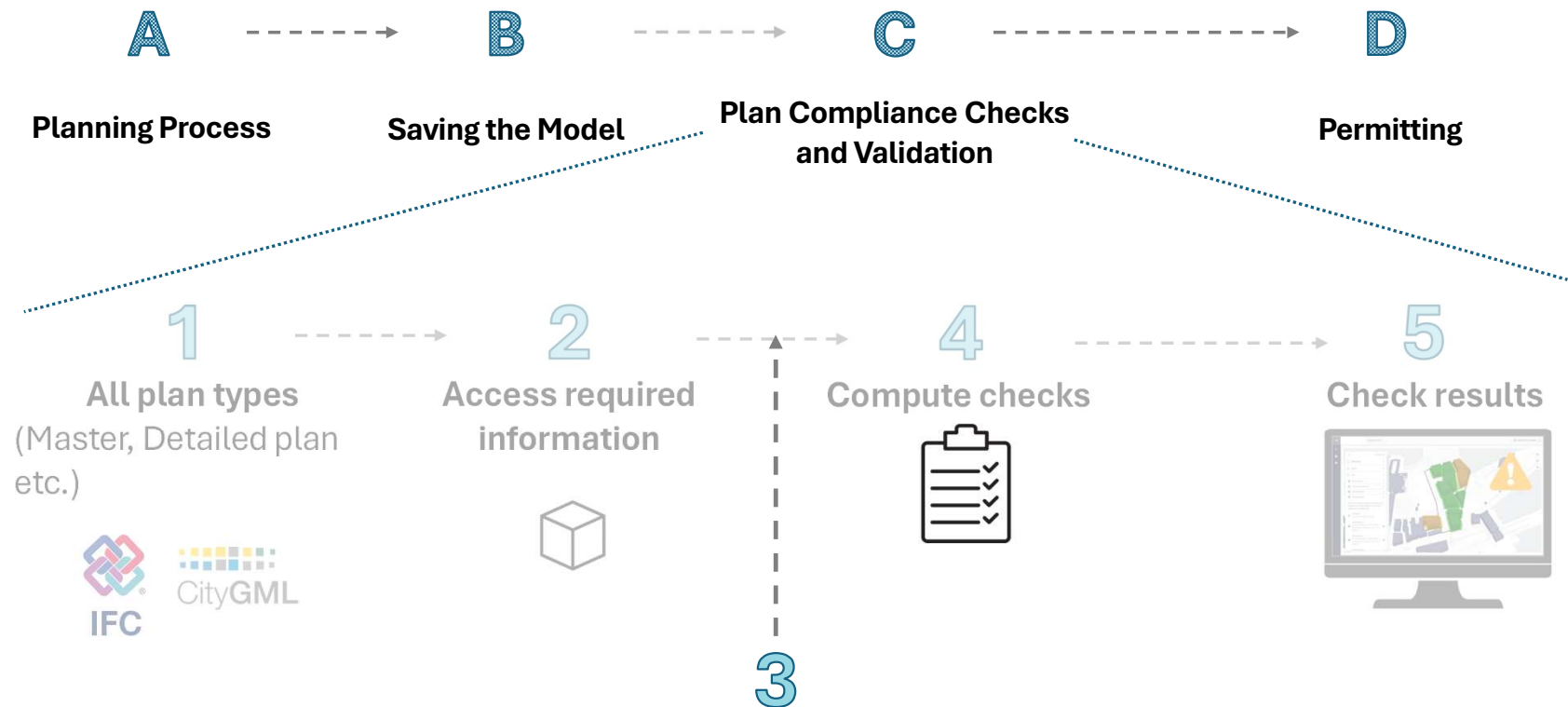
Research Problem

Hierarchical Spatial Plans as basis for Permitting



1. Introduction

Scope

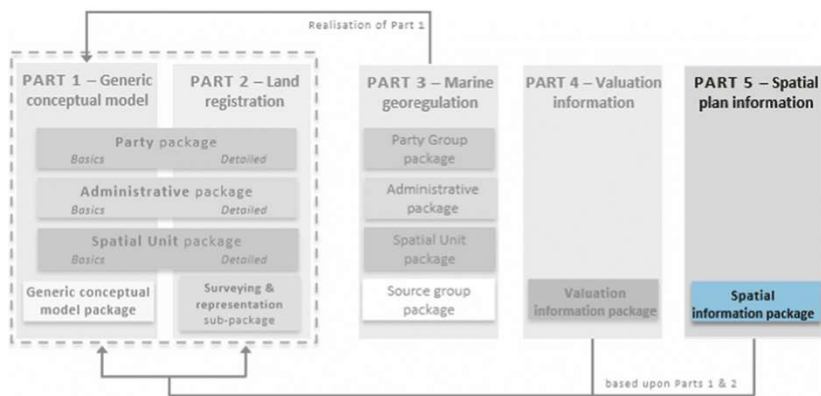


Store information through LADM Part 5

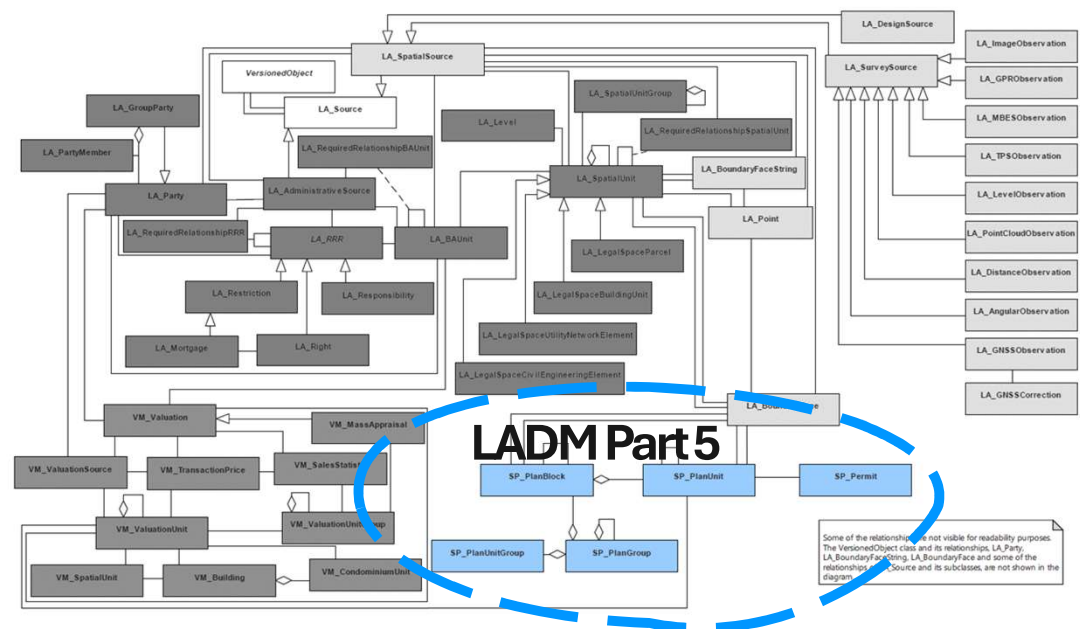
LADM can help to structure the plan data that is necessary to be able to execute the checks in a standardized and structured way.

1. Introduction

Scope



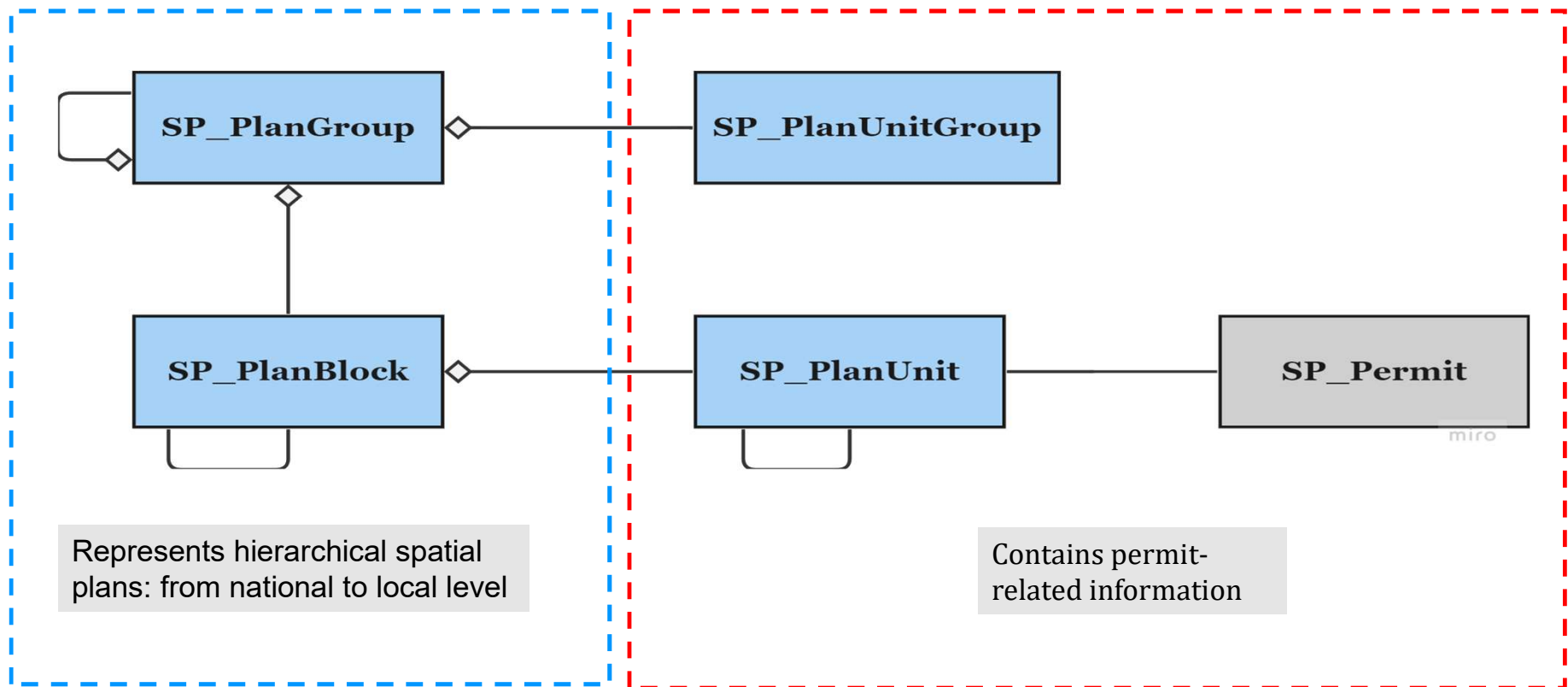
LADM Part 5: Spatial Plan Information



1. Introduction

Scope

LADM Part5



1. 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 Estonian coat of arms and the text "REGIONAAL- JA PÖLLUMAJANDUSMINISTEERIUM" on the left, and "DATA GOT OF PLANEERATIONS" on the right, along with "Accessibility" and "Inpuuten" links.

A left sidebar contains three menu items: "Search", "Map", and "Checking". The main content area features a search filter section with the following elements:

- Planetary name / Data collection ID / Plan ID / Kov ID (with a close button)
- Local government / Address / Catastritus (with a close button)
- Type of planning: A dropdown menu is open, showing options: "Detail planetary", "Special planning of local govern...", "County planning", "State special planning", and "General plan".
- Designer (with a close button)
- Condition: A dropdown menu is open, showing options: "valid" and "partially valid".
- Period of performance (with a calendar icon and a close button)
- Buttons: "Empty filters" and "I'm looking" (with a magnifying glass icon).

Below the search filters, a welcome message reads: "Welcome to use the established planning data collection".

Two paragraphs of text follow:

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](#)

At the bottom left, a status bar shows "K-N 9.00-12.00" and "Version: 1.73.0".

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

1. Introduction

Methodology

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

ii. Create and use the LADM database to store data

PostgreSQL

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

FME

iv. Integration with the compliance checks

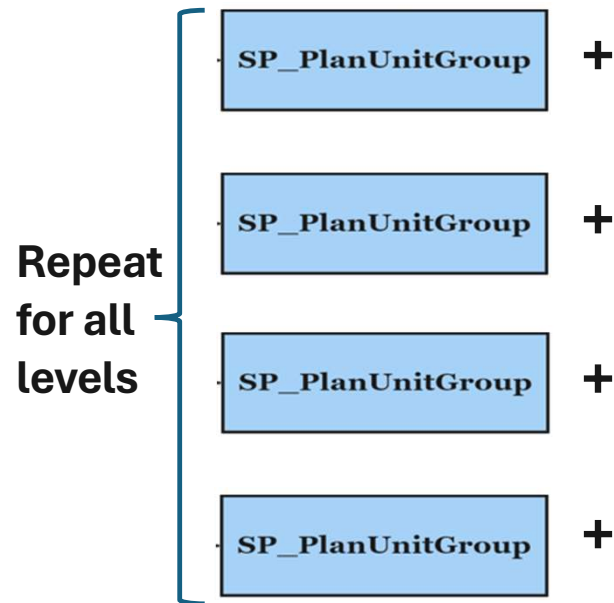
2. Estonia country profile

Relevant information/knowledge

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

2. Estonia country profile

LADM Part 5



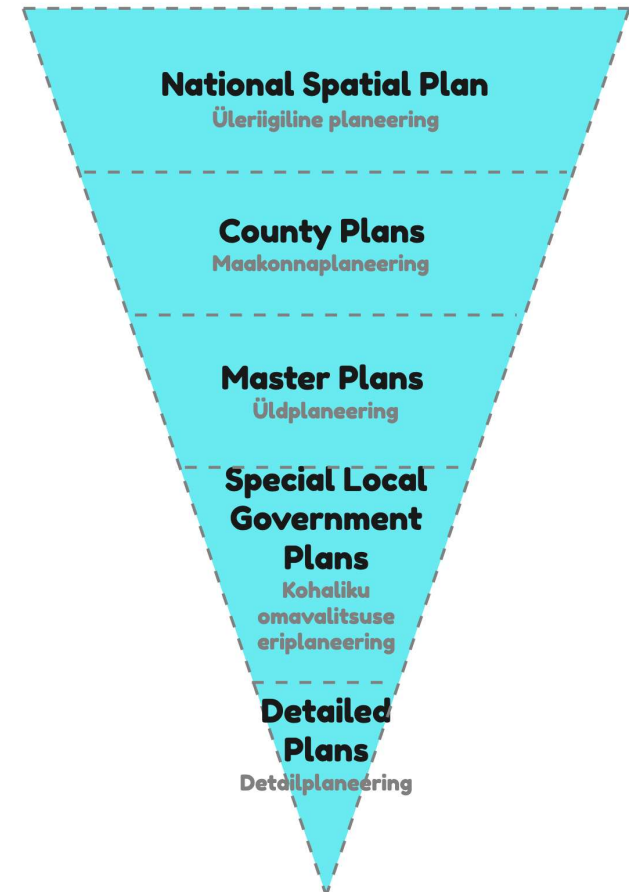
Except lowest level



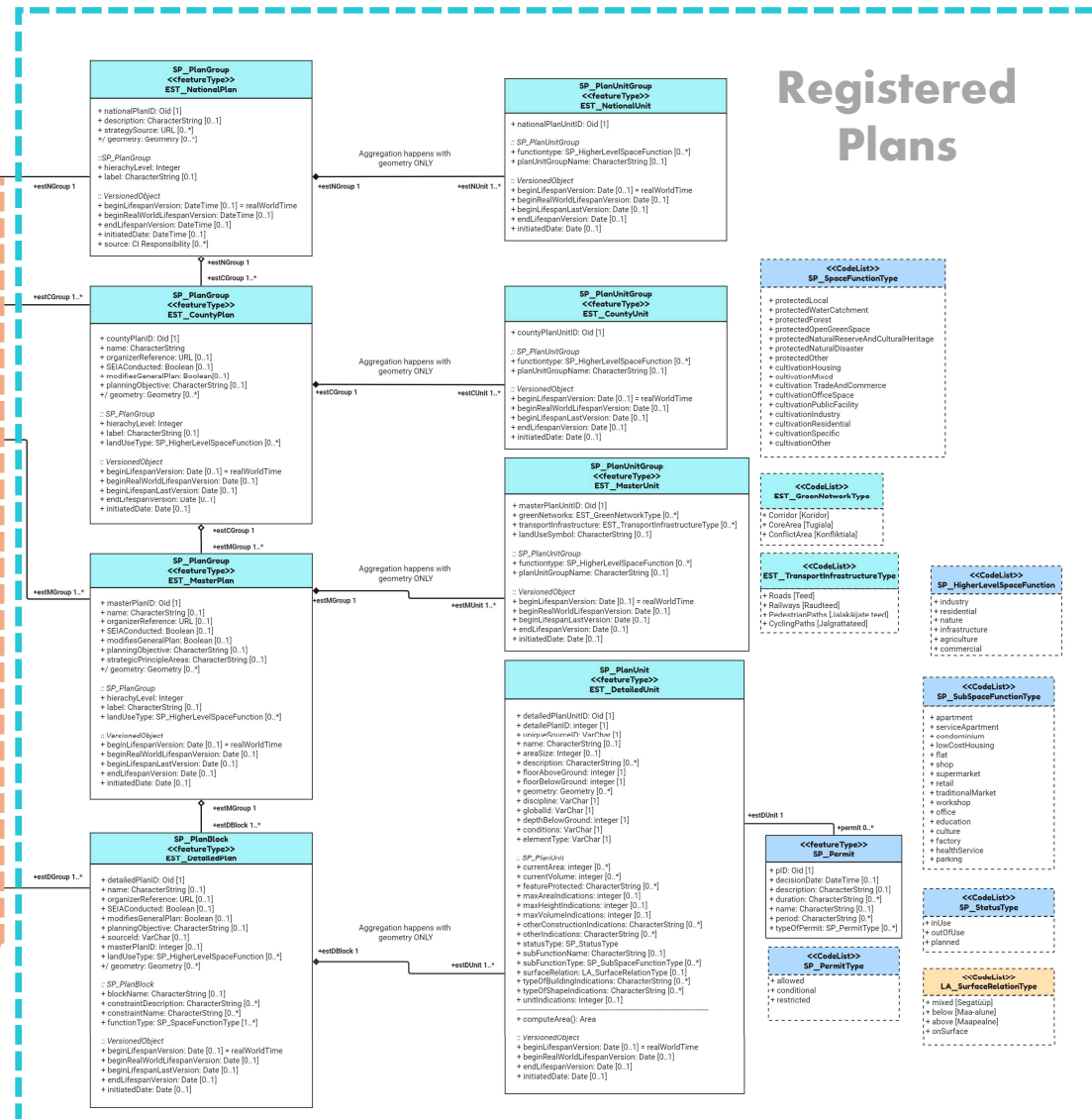
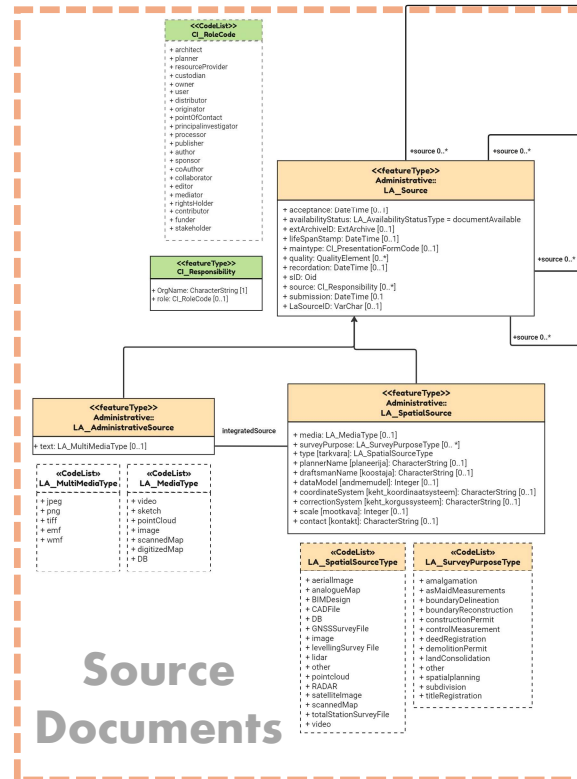
LADM Classes

<<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..*] + pblID: Oid + protectedSite: SP_ProtectedClassificationValue [0..*] + restrictionZone: SP_RestrictionZoneType [0..*] + technologicalRiskSafetyArea: CharacterString [0..*]

Estonia Spatial Plans

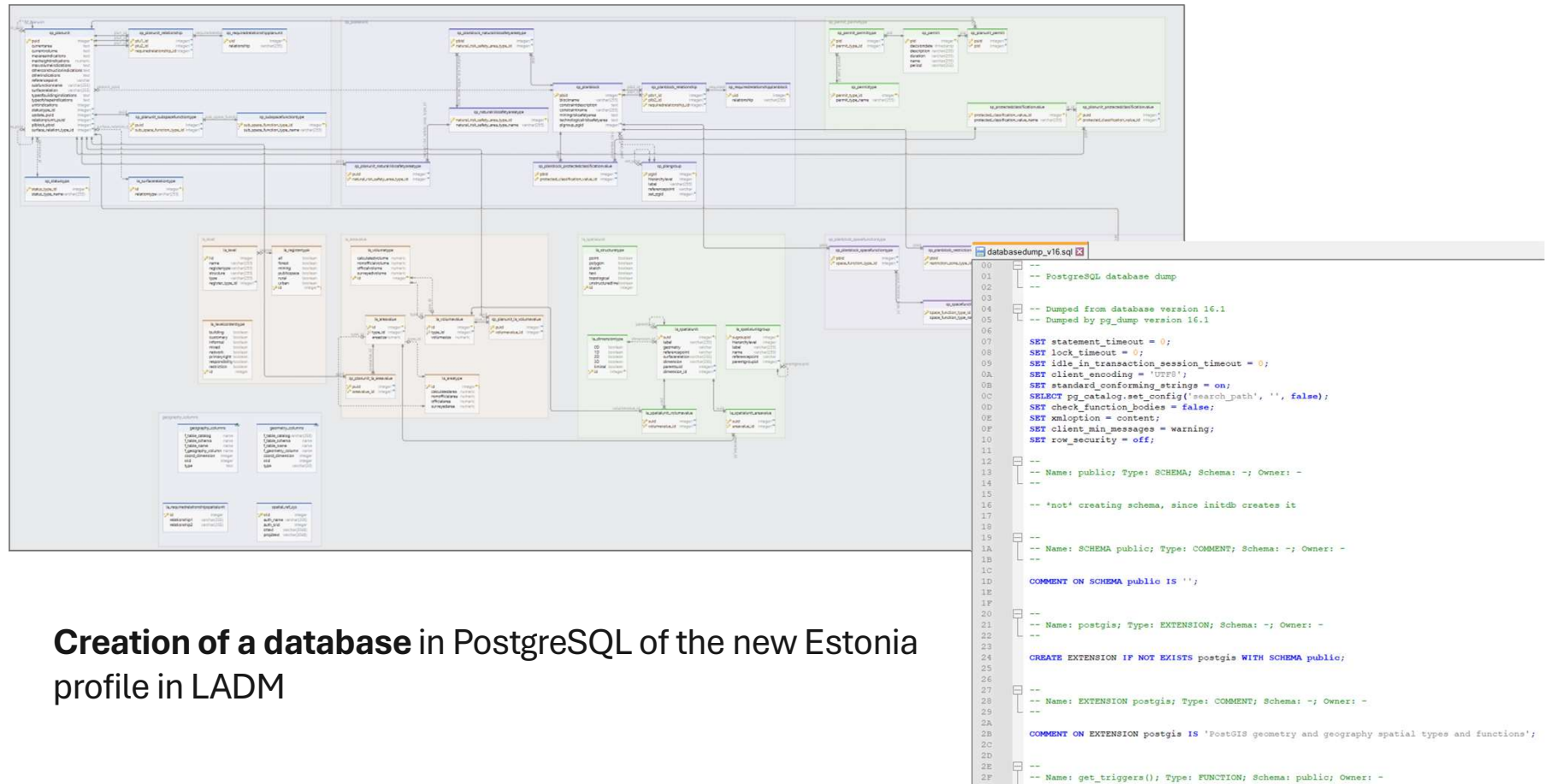


2. Estonia country profile



3. Implementation

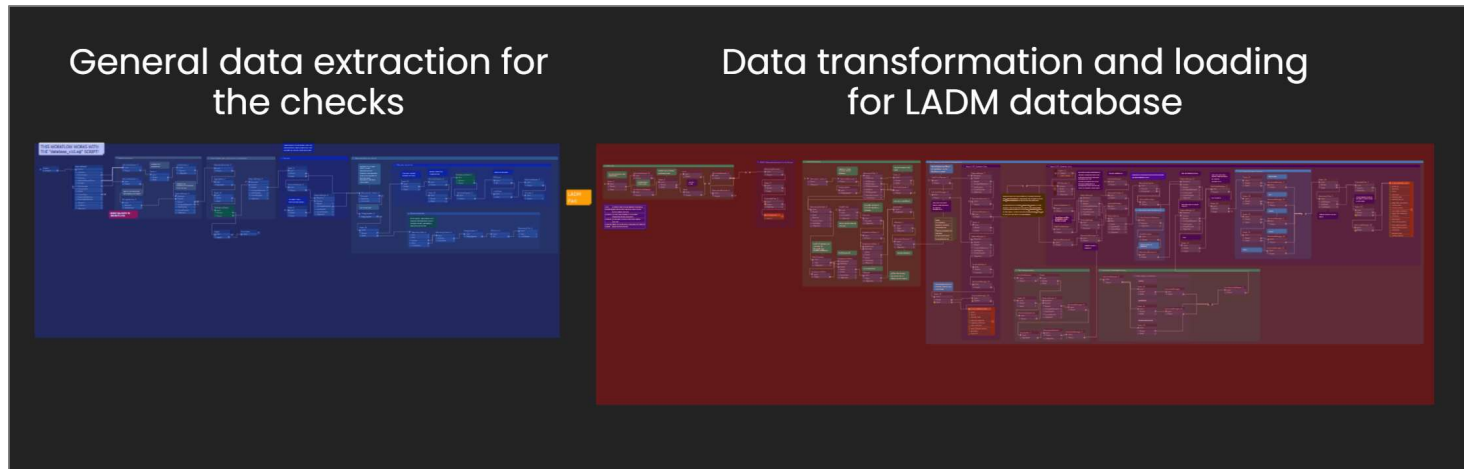
LADM Database Setup (from UML to SQL/DDL)



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

3. Implementation

Import plans to the database



3. 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

<<featureType>> EST_MasterPlan		SP_PlanGroup
+ 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]		

<<featureType>> EST_DetailedUnit		SP_PlanUnit
+ 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..*] + typeOfShapelIndications: 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]		

3. 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;
```


3. Implementation

List of Compliance Checks

1. Version comparison of detailed plans (DP vs DP)
- 2. Maximum building height (DP vs MP)**
3. Building distance (DP)
4. Cadastral border distance (DP)
5. Fire hydrants (DP vs MP)
- 6. Greenery demands (%) (DP vs MP)**
7. General access to the plot (DP vs MP)
8. Protected area requirements (DP vs MP)
9. Check area measures (DP vs MP)
10. Design in buildable area (DP)

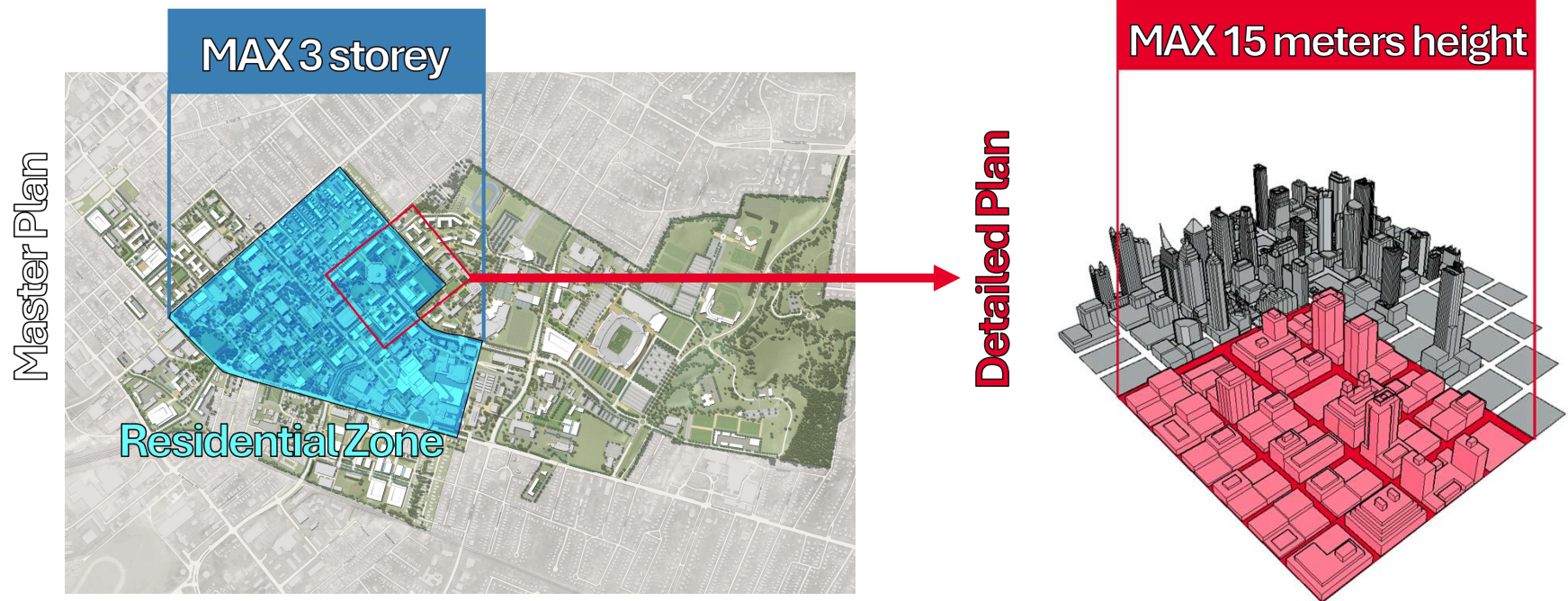
Some checks need only Detailed Plans (DP) for local rules, while others need both Master and Detailed Plans (MP-DP) for broader compliance.

[Detailed Plans (DP), Master Plans (MP)]

4. Implementation

List of Compliance Checks: *Example*

Does the Detail Plan comply against Master Plan regulations w.r.t. Maximum building height ?

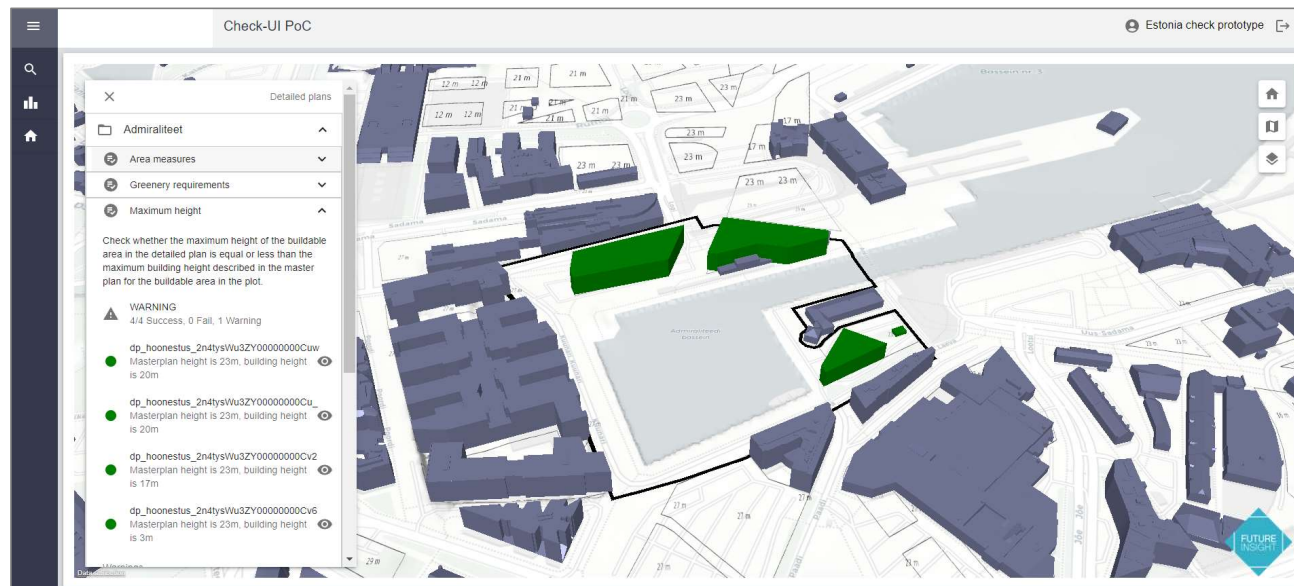


4. Implementation

List of Compliance Checks: *Example*

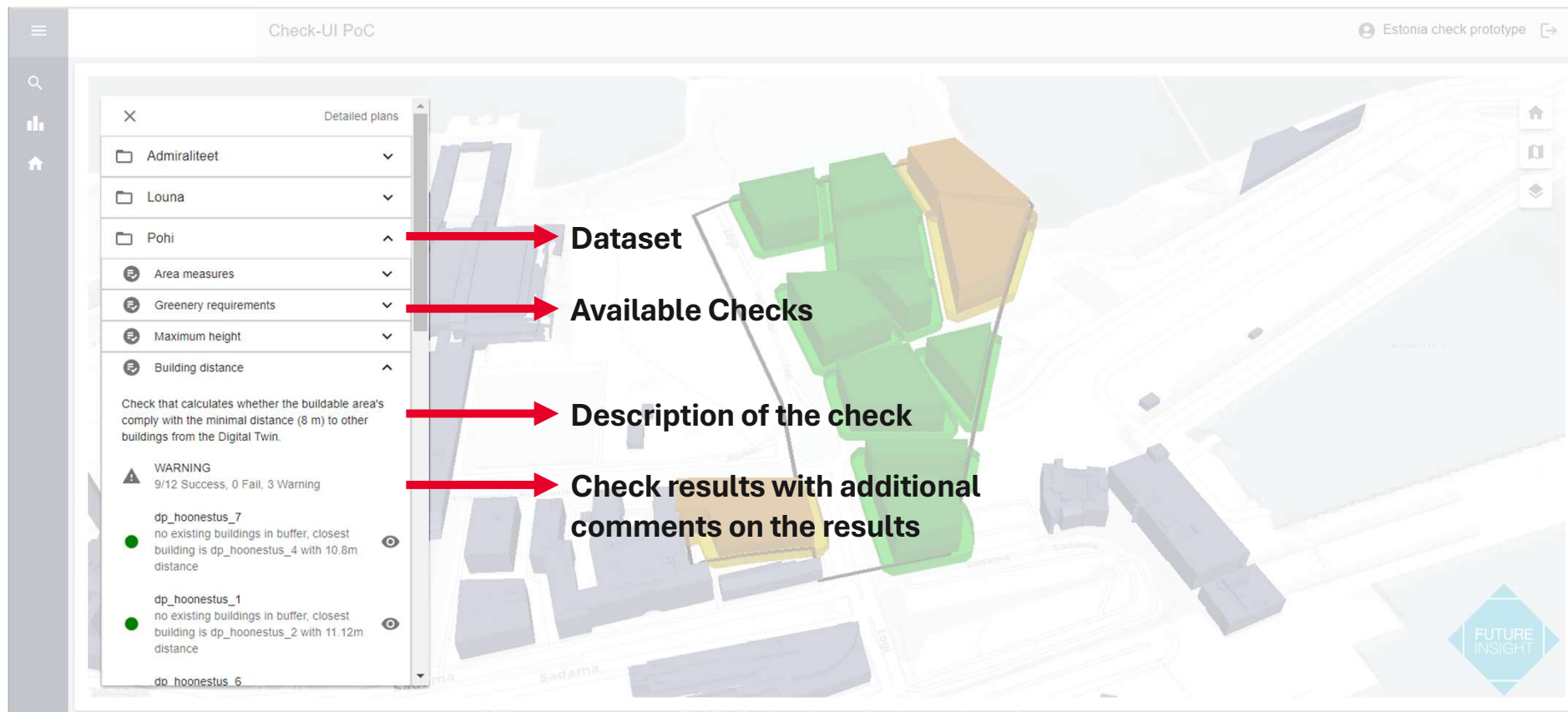
“The height of the buildable area in **Detailed Plan** cannot exceed the max. height of the **Master Plan**”

Visualize the results of the detailed plan check



4. Implementation

Options in the user interface



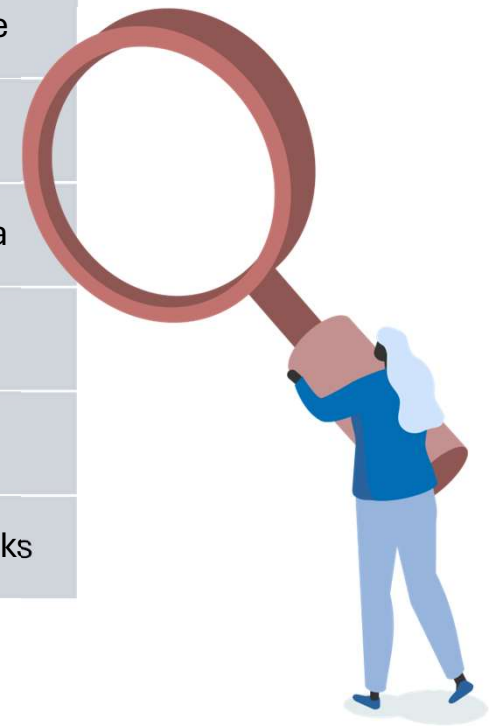
5. Conclusion

- The integration of LADM Part 5 with BIM/IFC models improves standardization and interoperability in compliance checks between spatial plans, enhancing quality and consistency of plans as basis for the permitting process in Estonia
- The case study demonstrated that using digital models streamlines the compliance check process, reducing errors and improving efficiency compared to traditional manual methods



4. 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



4. ISO DIS 19152-5 feedback



- LADM Part 5 classes and attributes align well with spatial plan data and infrastructure of Estonia
- The framework is flexible enough to add or omit necessary features
- The Geometry attribute is notably missing from plan classes (e.g., SP_PlanUnit, SP_PlanUnitGroup), indirect via LA_BoundaryFaceString and LA_BoundaryFace
- It would be helpful for the standard to include example country profiles to assist with implementation

Thank you.