

Developing a database for the LADM-IndoorGML model

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Introduction:

In our previous work, we have covered the issues that related to the transformation tool in Enterprise Architect (EA) such as:

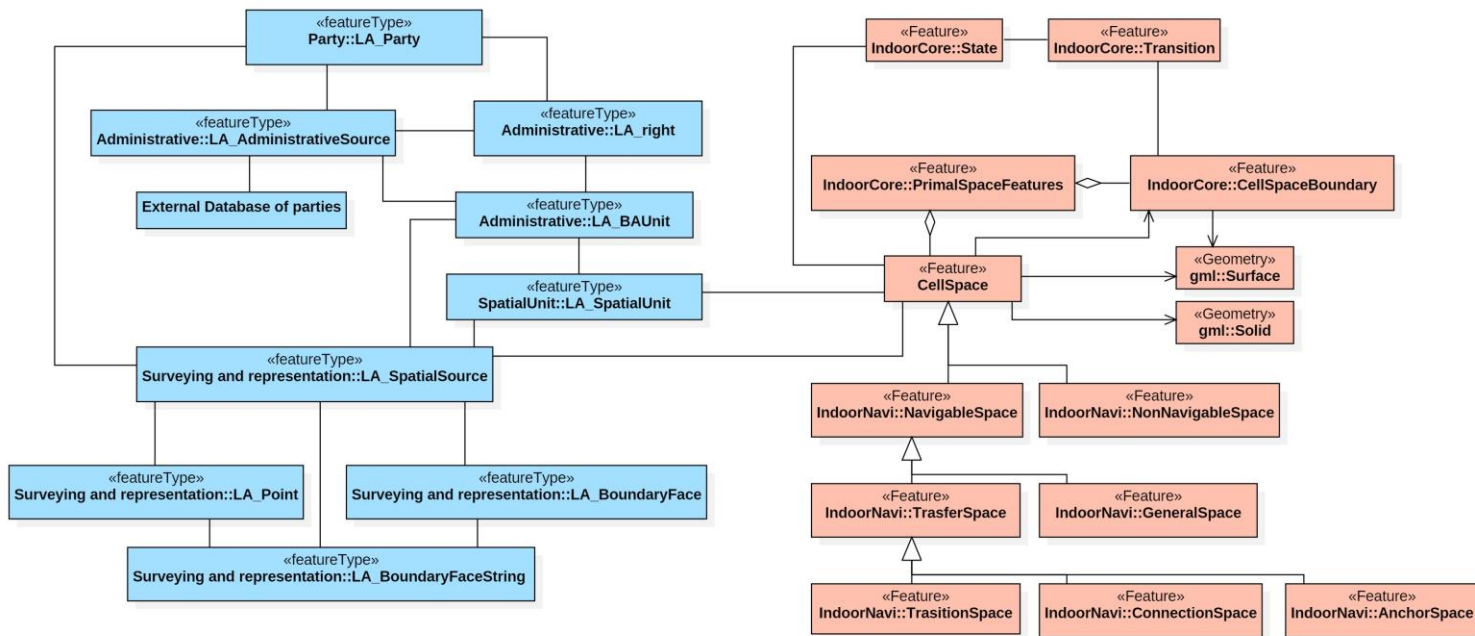
- Inheritance (Flat model, Super class and Children class)
- Primary key and a Foreign key
- Attributes Multiplicity and Constraints
- Data Type
- Spatial Data Type
- Code List
- Indexing (B-tree and R-tree)

Also Incomplete UML model For IndoorGML standard
ISO TC211 used to prepare LADM-IndoorGML UML model.



Goal:

Is to investigate all issues that related to generating the database and visualizing the content of the database.

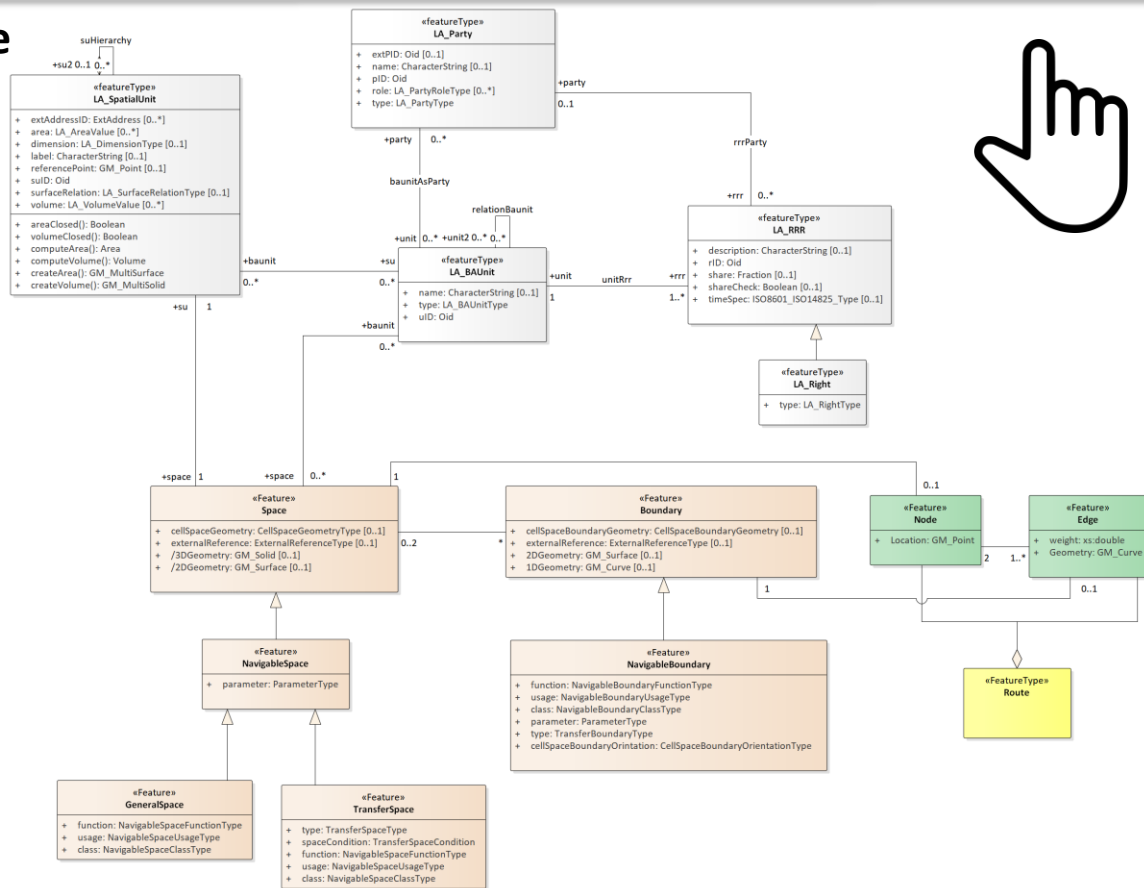


The conceptual model of LADM (blue) and IndoorGML (red)

Generating and assessing database for the conceptual model

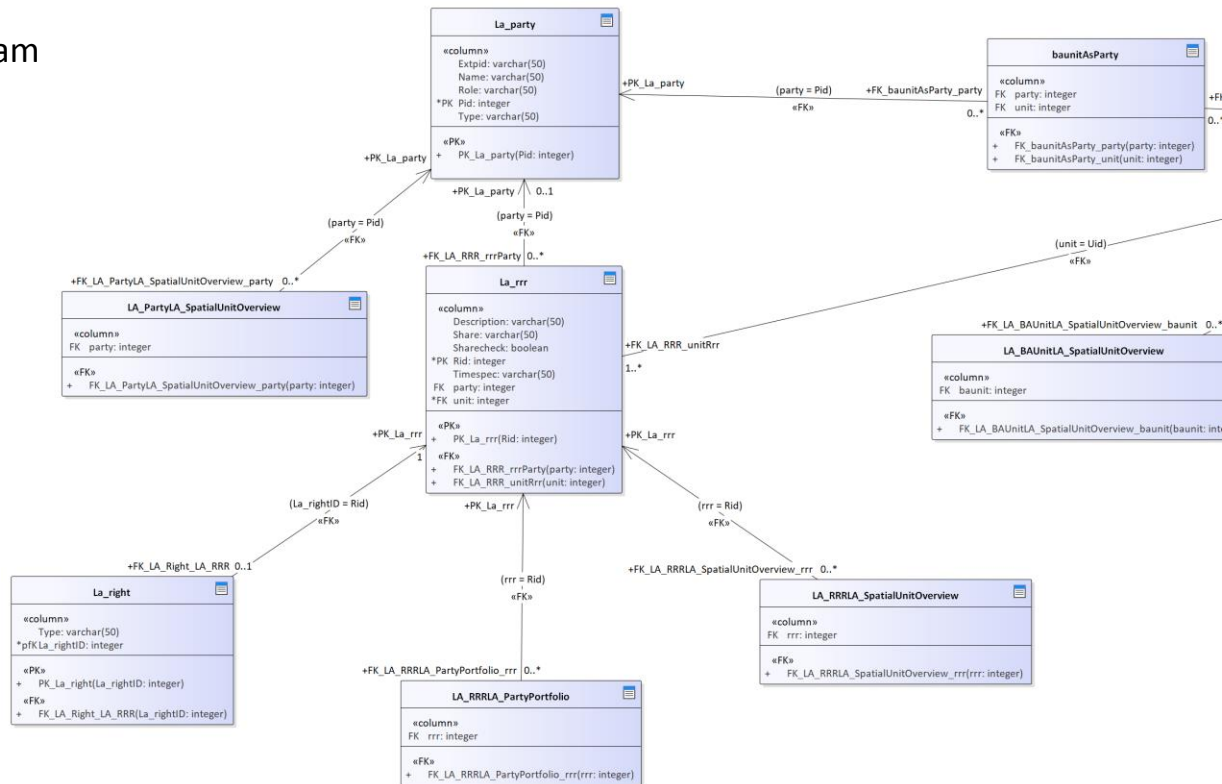
- Transformation to technical model

Selected classes from the conceptual model of LADM-IndoorGML



Generating Tables Diagram from the UML Diagram

Part of the table diagram



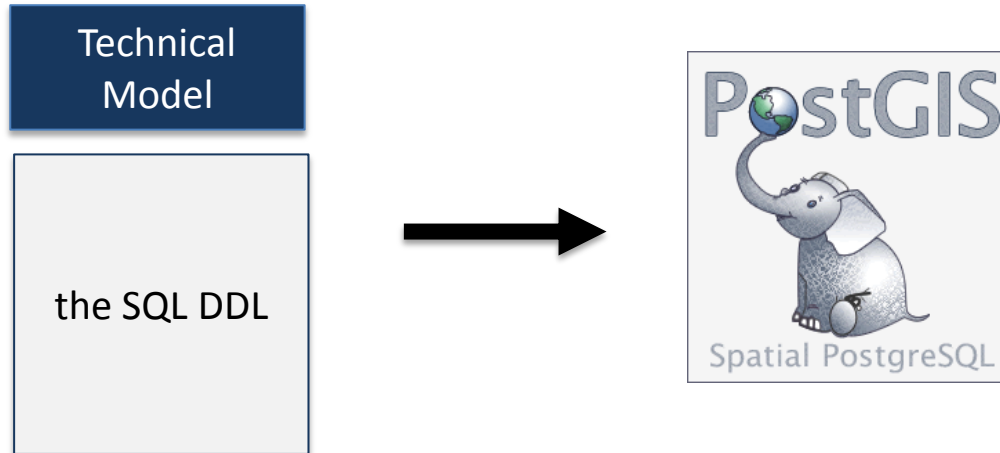
- **Generating SQL from UML Table Diagram**

```
CREATE TABLE La_rrr
(
  Description varchar(50) NULL,
  Share varchar(50) NULL,
  Sharecheck boolean NULL,
  Rid integer NOT NULL,
  Timespec varchar(50) NULL,
  party integer NULL,
  unit integer NOT NULL
)
;
CREATE TABLE La_spatialunit
(
  Extaddressid varchar(50) NULL,
  Area varchar(50) NULL,
  Dimension varchar(50) NULL,
  Label varchar(50) NULL,
  Referencepoint geometry(point) NULL,
  Surfacereletion varchar(50) NULL,
  Suid integer NOT NULL,
  Volume varchar(50) NULL,
  su2 integer NULL,
  space integer NOT NULL
)
;
```

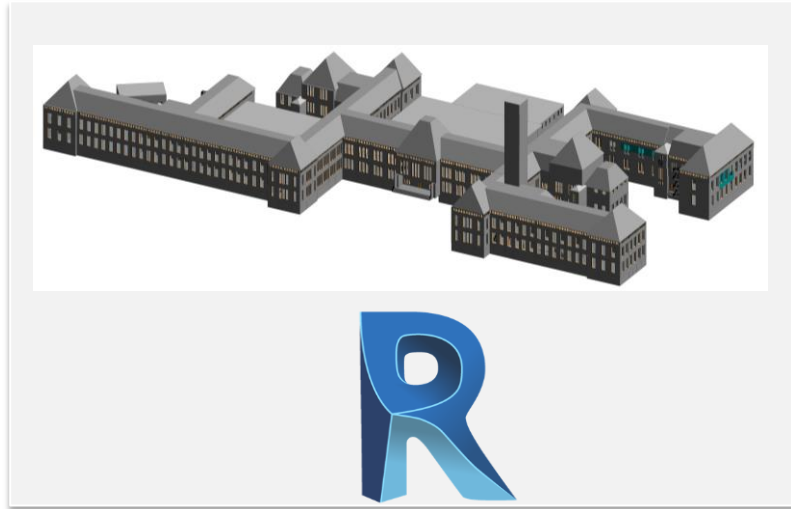
- **Generating Database and visualizing the data**

There are three steps to create database for the conceptual model of LADM-IndoorGML

First step (Integration model to database)

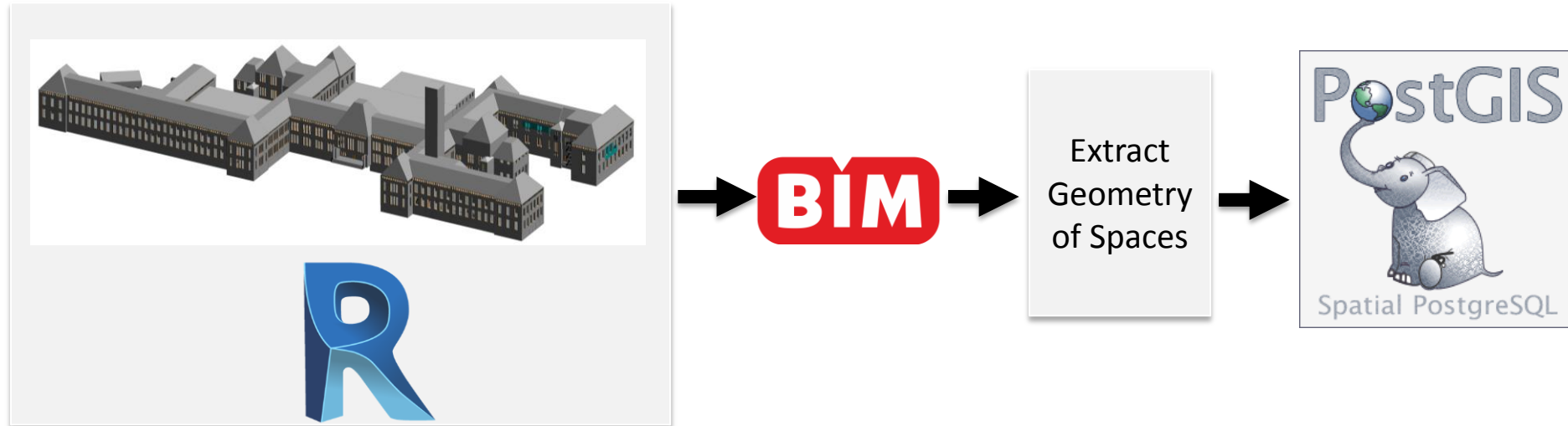


- **Generating Database and visualizing the data**
Second step (Semantic and schedule information)

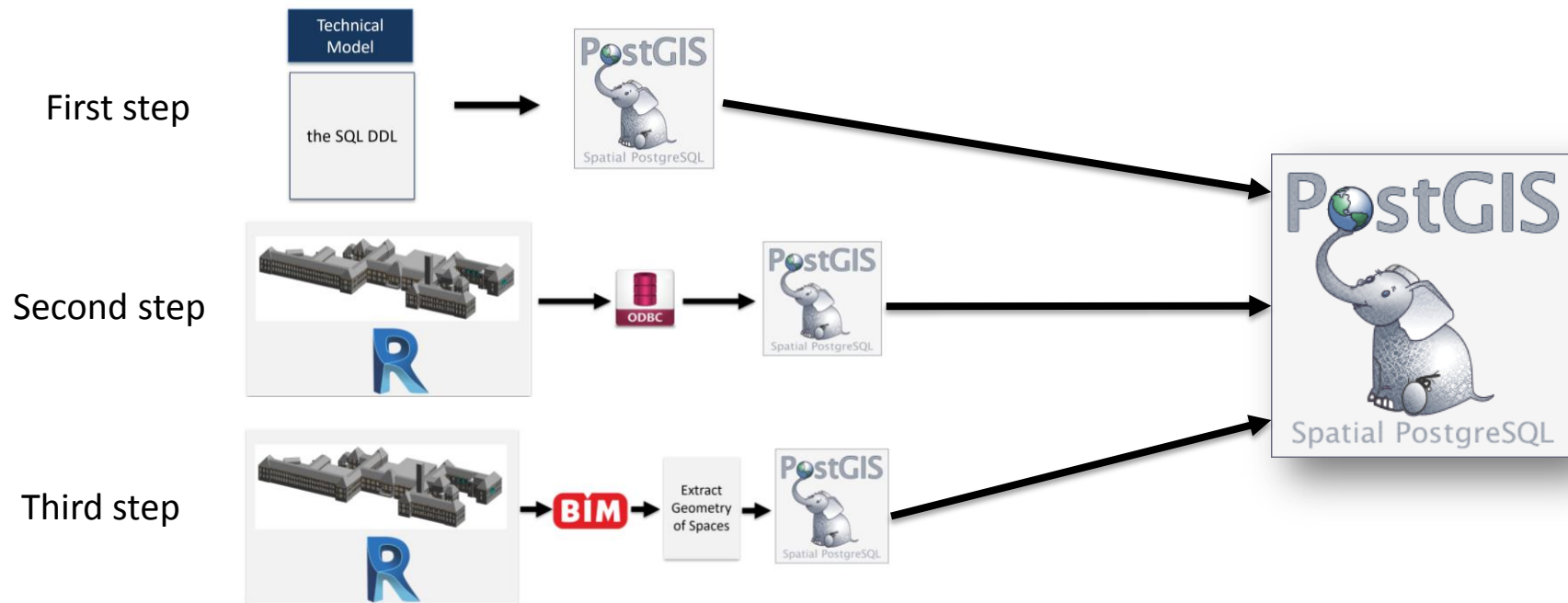


- **Generating Database and visualizing the data**

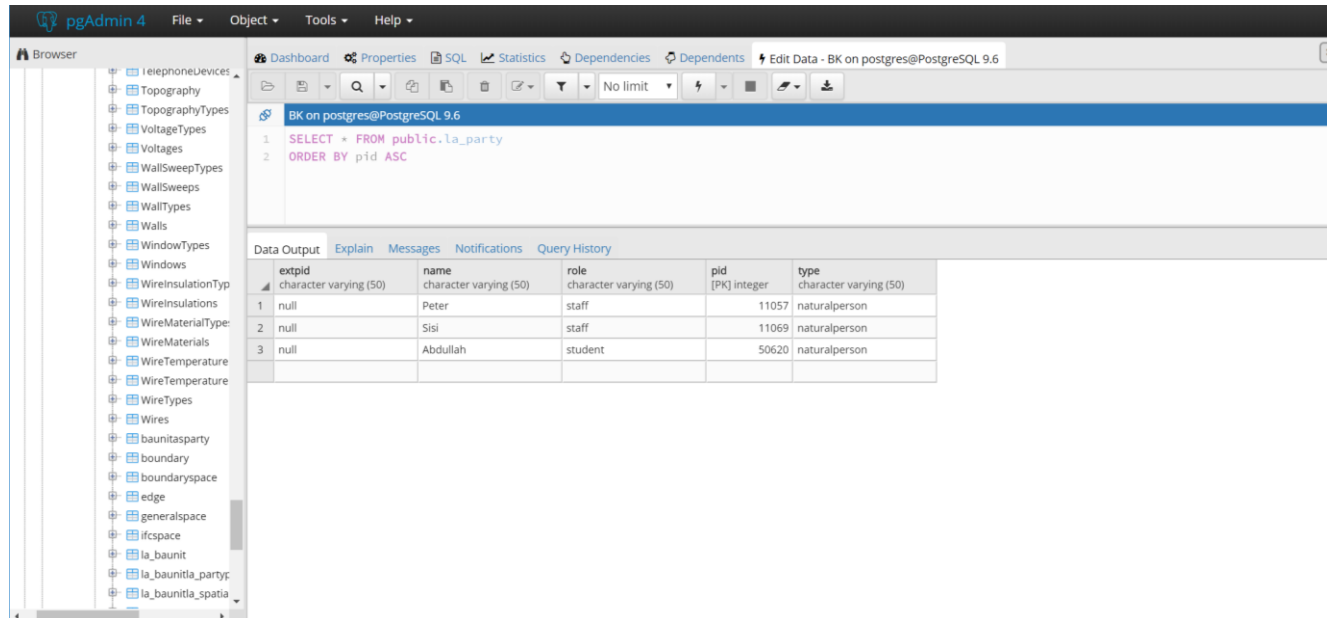
Third step (extract Spaces)



- Generating Database and visualizing the data



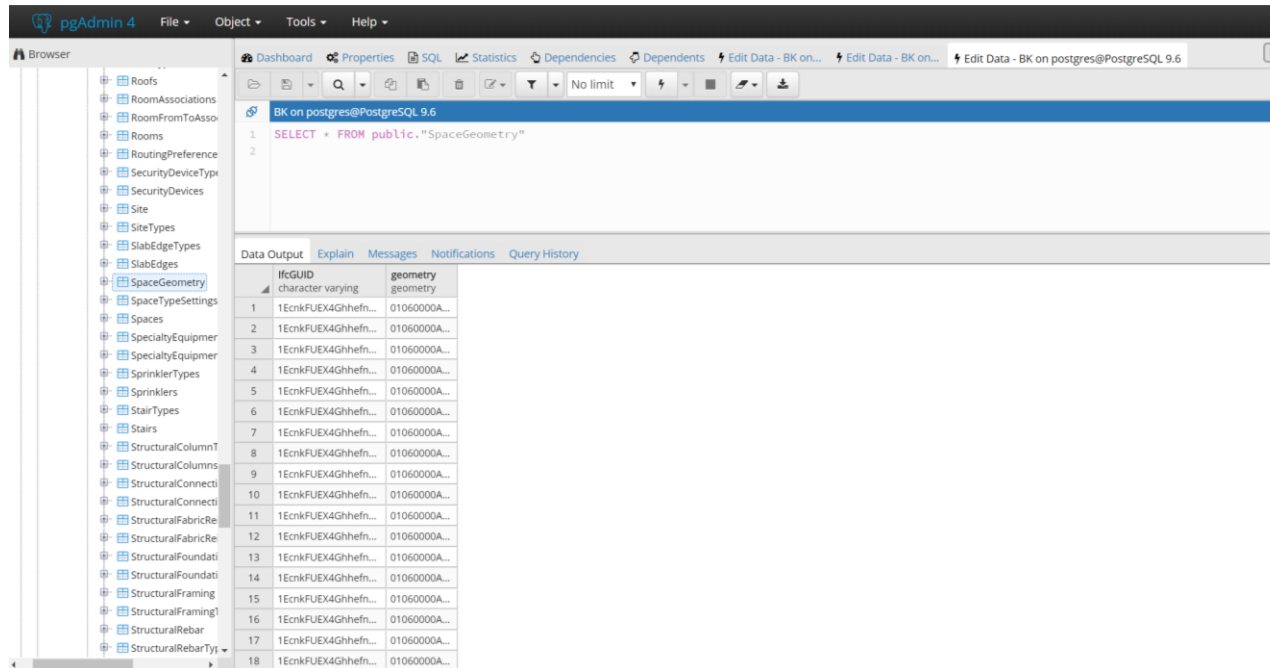
- Populate database in PostgreSQL



The screenshot shows the pgAdmin 4 interface. On the left, the 'Browser' pane displays a tree of database objects. The 'SQL' pane on the right shows a query: `SELECT * FROM public.la_party ORDER BY pid ASC`. Below the query, the 'Data Output' tab displays the results of the query in a table format.

extpid	name	role	pid	type
character varying (50)	character varying (50)	character varying (50)	[PK] integer	character varying (50)
1	Peter	staff	11057	naturalperson
2	Sisi	staff	11069	naturalperson
3	Abdullah	student	50620	naturalperson

- Populate database in PostgreSQL



The screenshot shows the pgAdmin 4 interface. On the left, the 'Browser' pane lists various database objects, with 'SpaceGeometry' selected. The main pane displays the 'SQL' tab with a query: `SELECT * FROM public."SpaceGeometry"`. Below the query, the 'Data Output' tab shows a table with two columns: 'IfcGUID' (character varying) and 'geometry' (geometry). The table contains 18 rows of data, each starting with a GUID and followed by a geometry value.

	IfcGUID	geometry
1	1EcnkFUEx4Ghhefn...	01060000A...
2	1EcnkFUEx4Ghhefn...	01060000A...
3	1EcnkFUEx4Ghhefn...	01060000A...
4	1EcnkFUEx4Ghhefn...	01060000A...
5	1EcnkFUEx4Ghhefn...	01060000A...
6	1EcnkFUEx4Ghhefn...	01060000A...
7	1EcnkFUEx4Ghhefn...	01060000A...
8	1EcnkFUEx4Ghhefn...	01060000A...
9	1EcnkFUEx4Ghhefn...	01060000A...
10	1EcnkFUEx4Ghhefn...	01060000A...
11	1EcnkFUEx4Ghhefn...	01060000A...
12	1EcnkFUEx4Ghhefn...	01060000A...
13	1EcnkFUEx4Ghhefn...	01060000A...
14	1EcnkFUEx4Ghhefn...	01060000A...
15	1EcnkFUEx4Ghhefn...	01060000A...
16	1EcnkFUEx4Ghhefn...	01060000A...
17	1EcnkFUEx4Ghhefn...	01060000A...
18	1EcnkFUEx4Ghhefn...	01060000A...

BKAdmin 4 File Object Tools Help

Browser

- PostgreSQL 9.6
 - Databases (3)
 - BK
 - Casts
 - Catalogs
 - Event Triggers
 - Extensions (2)
 - plpgsql
 - postgis
 - Foreign Data Wrappers
 - Languages
 - Schemas (1)
 - public
 - Collations
 - Domains
 - FTS Configurations
 - FTS Dictionaries
 - FTS Parsers
 - FTS Templates
 - Foreign Tables
 - Functions
 - Materialized Views
 - Sequences
 - Tables (255)
 - AirTerminalTypes
 - AirTerminals
 - AreaLoads
 - AreaSchemes

Dashboard Properties SQL Statistics Dependencies Dependents Edit Data - BK on ...

BK on postgres@PostgreSQL 9.6

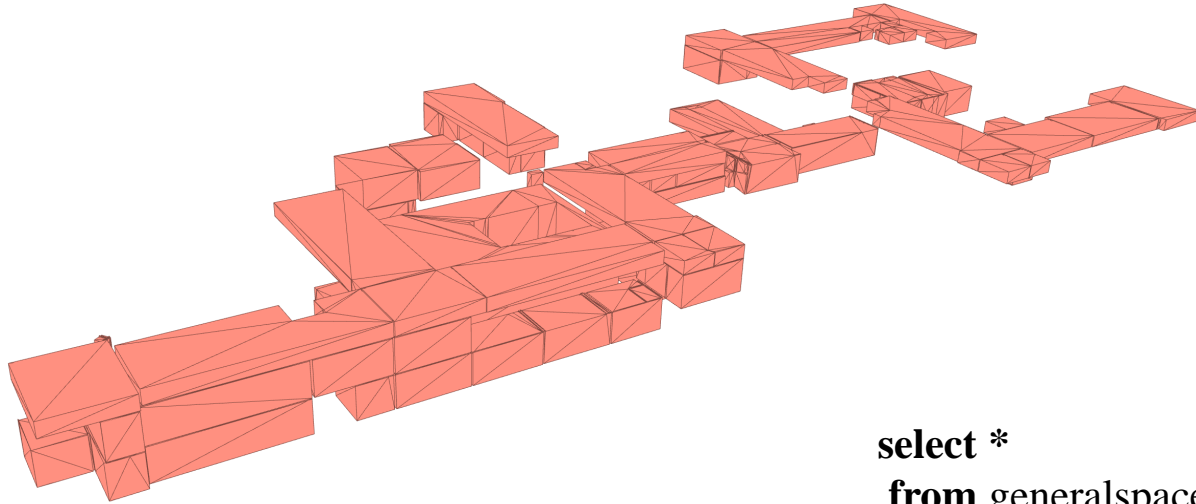
```

1 SELECT * FROM public.generalspace
2 ORDER BY generalspaceid ASC

```

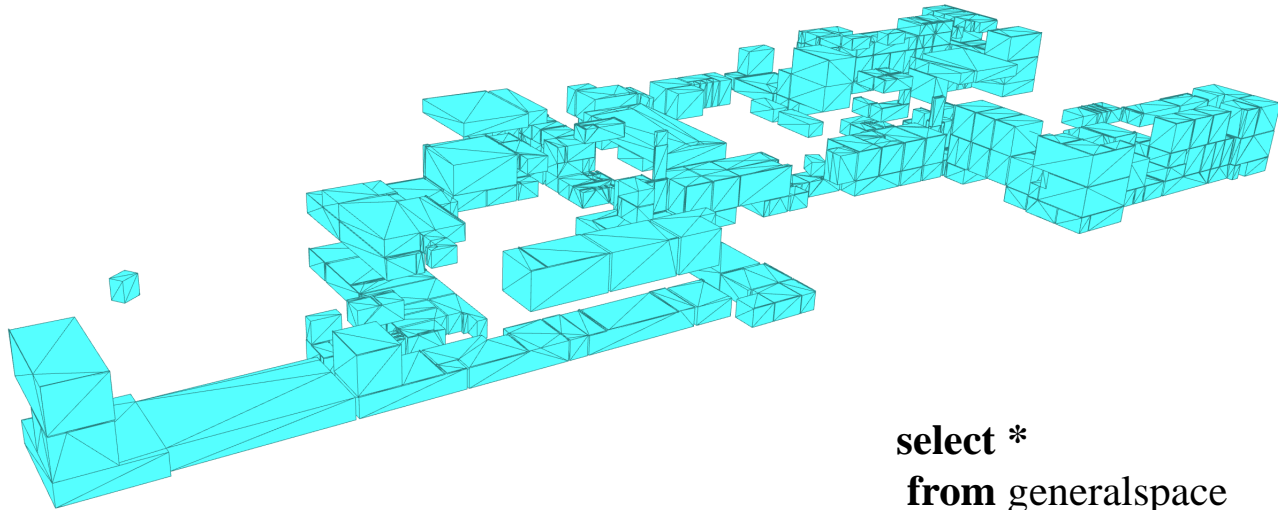
	Data Output	Explain	Messages	Notifications	Query History
	function character varying(50)	usage character varying(50)	class character varying(50)	generalspaceid [PK] integer	geom geometry
1	A4 Study room / area	student	A Education	1195344	01060000A.
2	H2 Hall	student, staff, visitor	H Horizontal traffic	1195345	01060000A.
3	A4 Study room / area	student	A Education	1195346	01060000A.
4	H1 Times	student, staff, visitor	H Horizontal traffic	1195349	01060000A.
5	H1 Times	student, staff, visitor	H Horizontal traffic	1195350	01060000A.
6	A4 Study room / area	student	A Education	1195351	01060000A.
7	H1 Times	student, staff, visitor	H Horizontal traffic	1195352	01060000A.
8	V1 Stairs	student, staff, visitor	V Vertical traffic	1195353	01060000A.
9	V2 Lift	student, staff, visitor	V Vertical traffic	1195354	01060000A.
10	V1 Stairs	student, staff, visitor	V Vertical traffic	1195355	01060000A.
11	V1 Stairs	student, staff, visitor	V Vertical traffic	1195356	01060000A.
12	A2-4 drawing room	student	A Education	1195357	01060000A.
13	A4 Study room / area	student	A Education	1195358	01060000A.
14	A4 Study room / area	student	A Education	1195359	01060000A.
15	T1 Toilet room	student, staff, visitor	S Sanitary	1195360	01060000A.
16	T1 Toilet room	student, staff, visitor	S Sanitary	1195361	01060000A.

- **Visualization Result**



```
select *  
from generalspace  
where usage = 'student';
```

- **Visualization Result**



```
select *  
from generalspace  
where usage = 'staff';
```


CONCLUSION

- This paper has presented the development of a database for the conceptual model of LADM-IndoorGML.
- Most of the issues that have been discussed in our previous work has been solved.
- This experiment has also illustrated a workflow for import of data into LADM-IndoorGML relational tables.
- The software package Revit is able to exports all textual data to Postgre/PostGIS with out the geometry.
- An ODBC importer was developed to import the 3D geometry of ifcSpace.
- Most of the tables of the schema have been populated in automated way.

Future work

- We will explore WebGL to develop a web user interface to provide interactive 3D visualizations within web browsers.
- Two web applications will be considered: maintenance and navigation (on a mobile device).
- The web user interface will be used to explore the relationship between the indoor spaces and the users to determine the rights of use for the indoor spaces.
- The subdivision of the indoor space will be examined to assess the accessibility of the indoor spaces based on the rights, restrictions, and responsibilities (RRRs).

Thank you