



Understanding **Buildings** using Machine Learning

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NOVALIAN

DEEP LEARNING



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OUR TEAM



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Data Engineer



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Data Scientist

70's



**Draw complex buildings
with strong constraints**



Now



**Draw complex buildings
with strong constraints**

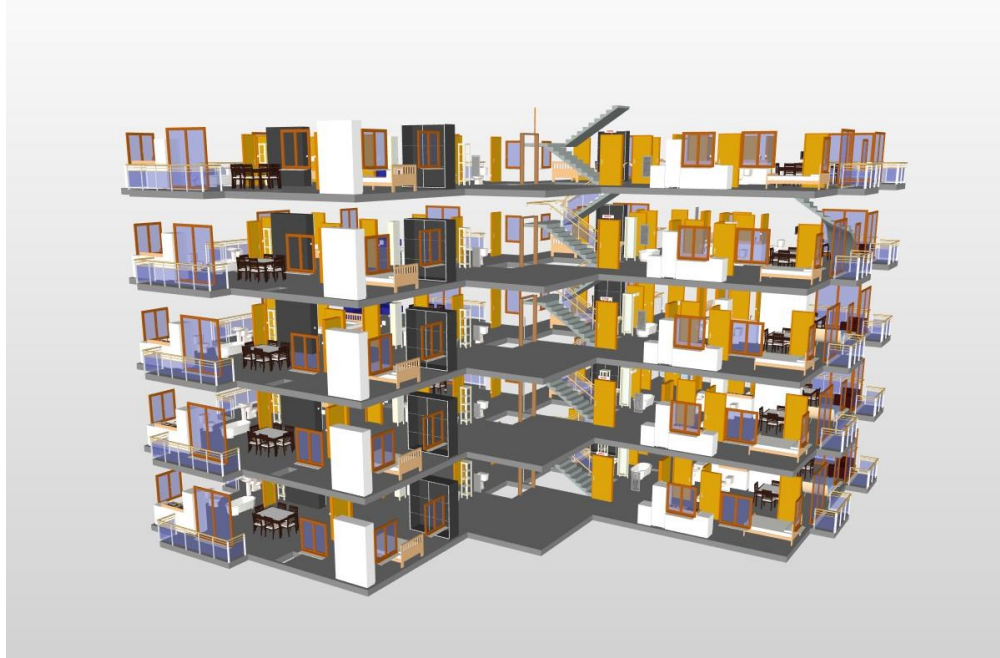


Standard exchange data model : IFC

PDF for BIM



GENERAL GEOMETRIC DATA INCONSISTENCY

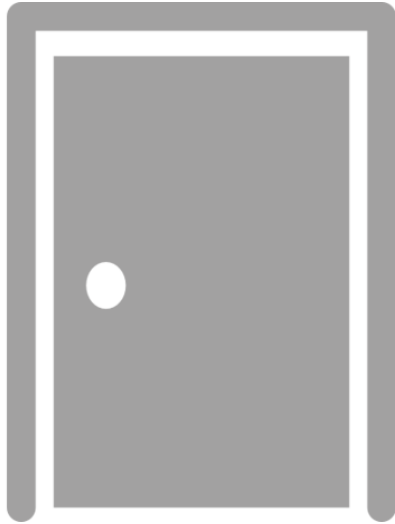


EXAMPLE

**Facade is one only wall,
related to one floor.**

Take others floors = no wall



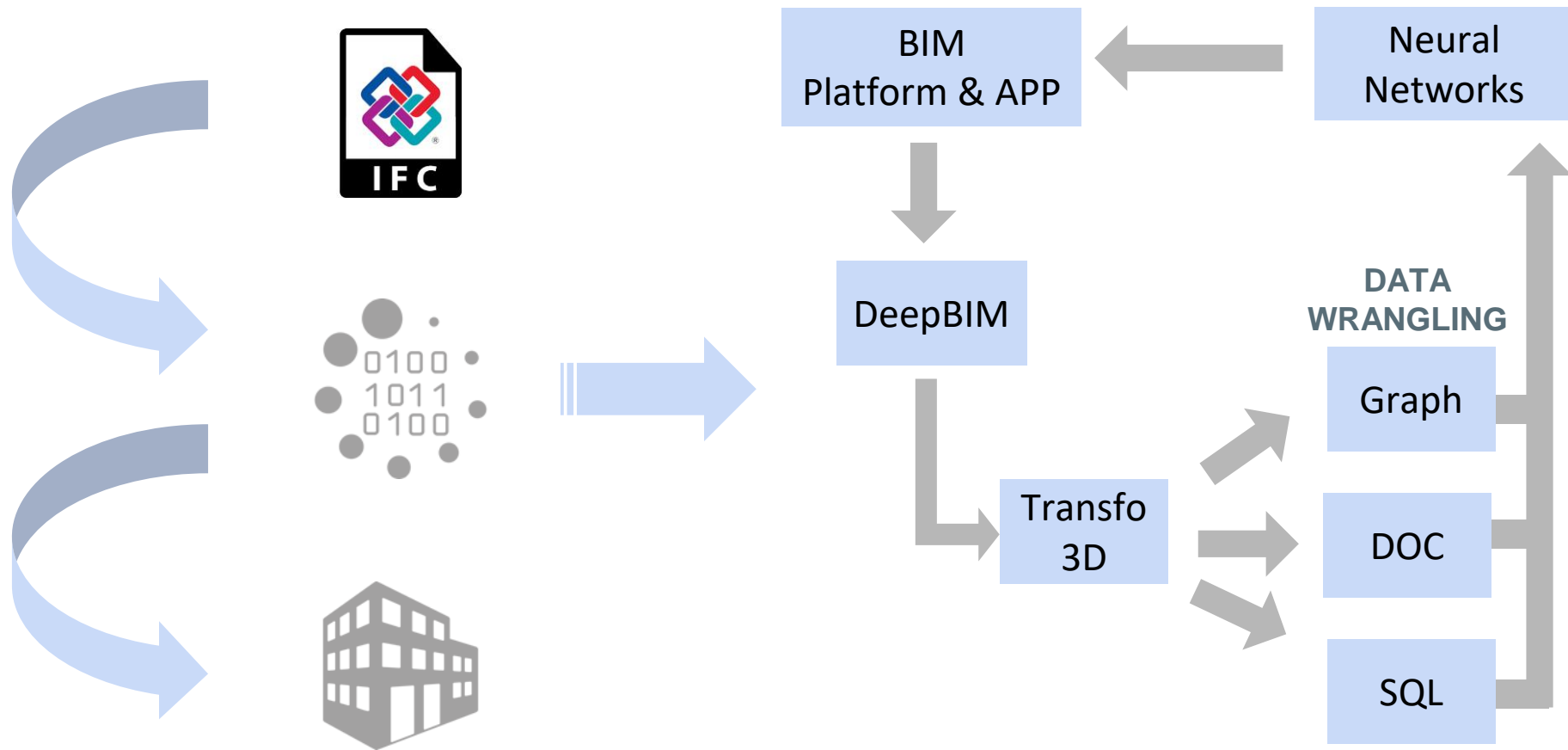


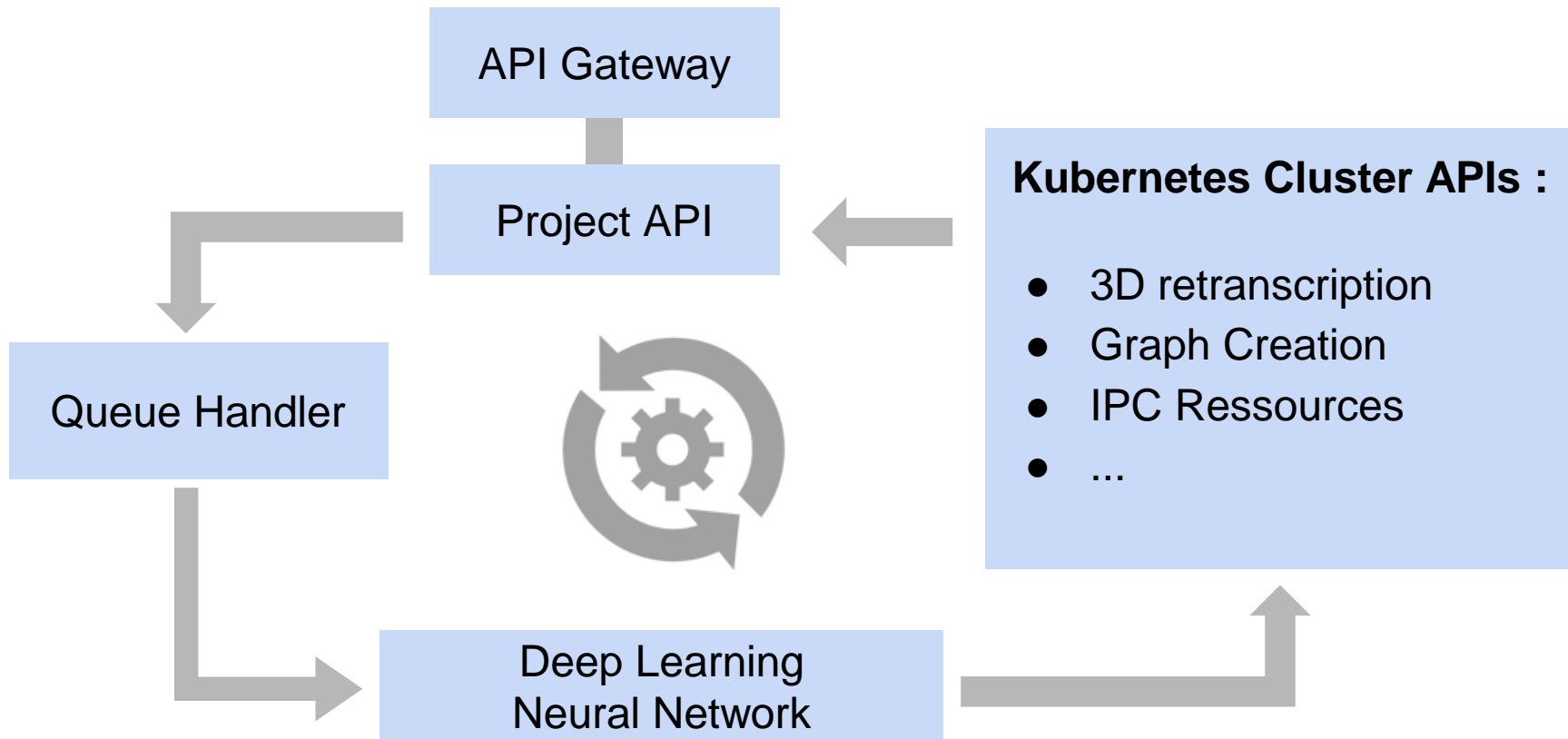
This is not a door.

EXAMPLE

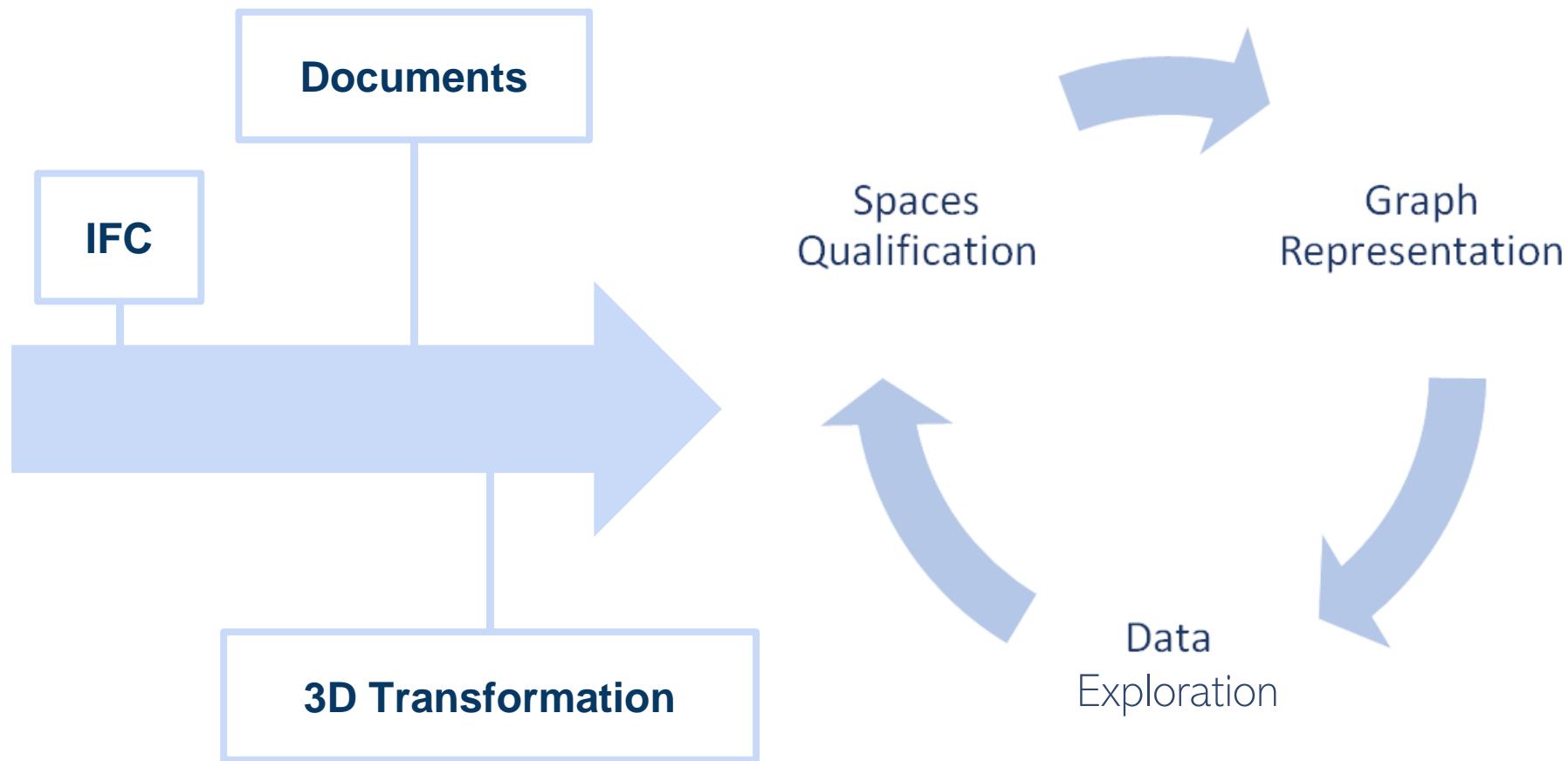
- Language
- Measuring unit
- Definition of a door
- Modelisation length vs Metadata length
- Depth of the door = depth of the wall ?
- ...

OUR SOLUTION : DeepBIM





DeepBIM : BUILDING INFORMATION MODEL



DeepBIM : FROM IMPLICIT DATA TO EXPLICIT DATA

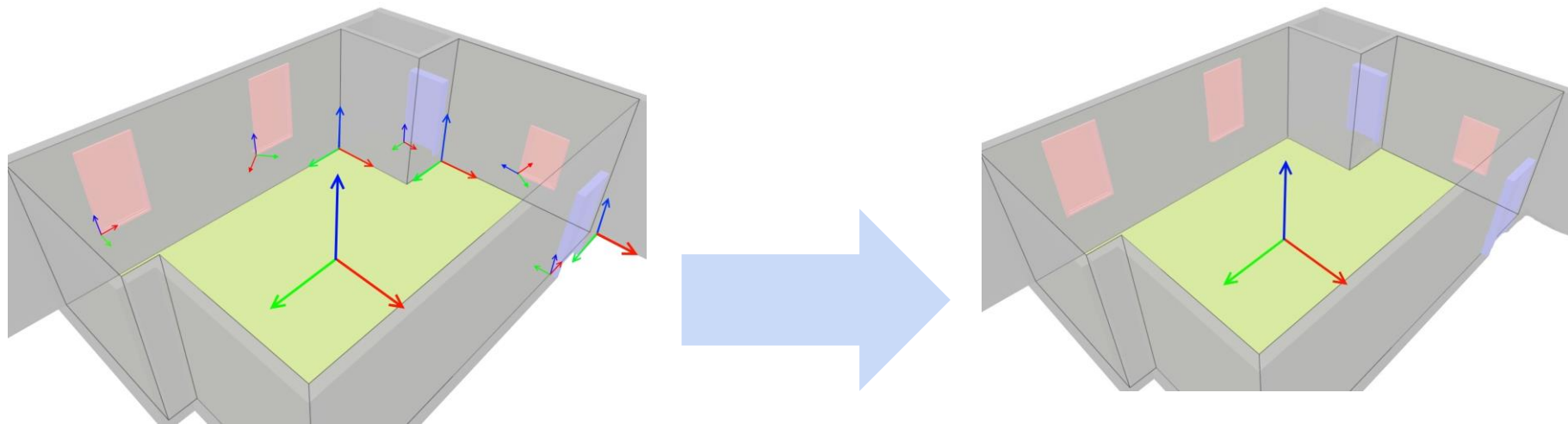
```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION(('ViewDefinition[CoordinationView_V2.0, QuantityTakeOffAddOn]
FILE_NAME('out.ifc', '2016-09-28T08:14:12', ('TASCHESTAALBOUW\l.r.kamphuis')), ('SI
Structures 20.0, IFC Export Version: 4.0.0.0 Mar 7 2014', ''));
FILE_SCHEMA(('IFC2X3'));
ENDSEC;

DATA;
#1= IFCPERSON('TASCHESTAALBOUW\l.r.kamphuis', 'Undefined', $, $, $, $, $, $);
#2= IFCORGANIZATION($, 'Tekla Corporation', $, $, $);
#3= IFCPERSONANDORGANIZATION(#1, #2, $);
#4= IFCAPPLICATION(#2, '20.0', 'Tekla Structures', 'Multi material modeling');
#5= IFCOWNERHISTORY(#3, #4, $, .NOCHANGE., $, $, $, 1475043169);
#6= IFCARTESIANPOINT((0., 0., 0.));
#7= IFCDIRECTION((1., 0., 0.));
#8= IFCDIRECTION((0., 1., 0.));
#9= IFCDIRECTION((0., 0., 1.));
#10= IFCAXIS2PLACEMENT3D(#6, #9, #7);
#11= IFCGEOMETRICREPRESENTATIONCONTEXT($, 'Model', 3, 1.E-005, #10, $);
#12= IFCGEOMETRICREPRESENTATIONSUBCONTEXT('Body', 'Model', *, *, *, *, #11, $, .MODEL_
#13= IFCGEOMETRICREPRESENTATIONSUBCONTEXT('Axis', 'Model', *, *, *, *, #11, $, .GRAPH_
#14= IFCGEOMETRICREPRESENTATIONSUBCONTEXT('FootPrint', 'Model', *, *, *, *, #11, $, .F
#15= IFCUNIT(*, .LENGTHUNIT., .MILLI., .METRE.);
#16= IFCUNIT(*, .AREAUNIT., $.SQUARE_METRE.);
#17= IFCUNIT(*, .VOLUMEUNIT., $.CUBIC_METRE.);
#18= IFCUNIT(*, .MASSUNIT., $.KILO., .GRAM.);
#19= IFCUNIT(*, .TIMEUNIT., $.SECOND.);
#20= IFCUNIT(*, .PLANEANGLEUNIT., $.RADIAN.);
#21= IFCUNIT(*, .SOLIDANGLEUNIT., $.STERADIAN.);
#22= IFCUNIT(*, .THERMODYNAMICTEMPERATUREUNIT., $.DEGREE_CELSIUS.);
#23= IFCUNIT(*, .LUMINOUSINTENSITYUNIT., $.LUMEN.);
#24= IFCUNITASSIGNMENT((#15, #16, #17, #18, #19, #20, #21, #22, #23));
#25= IFCPROJECT('1CPUG8PoX3KfTLxPax0N3q', #5, 'Saxion te Apeldoorn', $, $, $, $, (#1:
#26= IFCLOCALPLACEMENT($, #10);
#27= IFCSITE('1UPJgIJHf9j8ehzmdGnY8M', #5, 'Undefined', $, $, #26, $, $.ELEMENT., $, $
#28= IFCLOCALPLACEMENT(#26, #10);
```



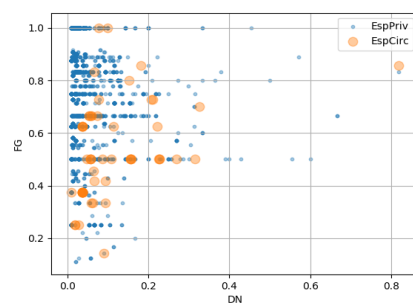
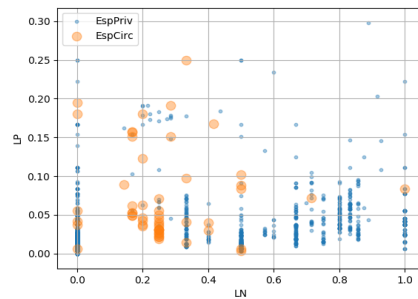
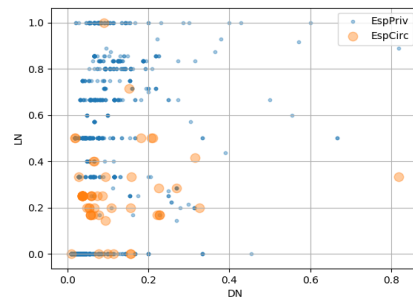
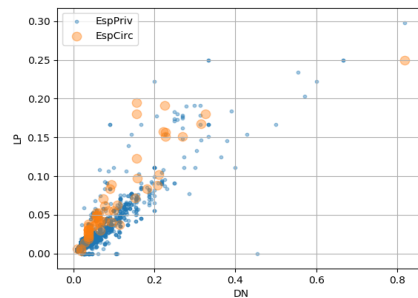
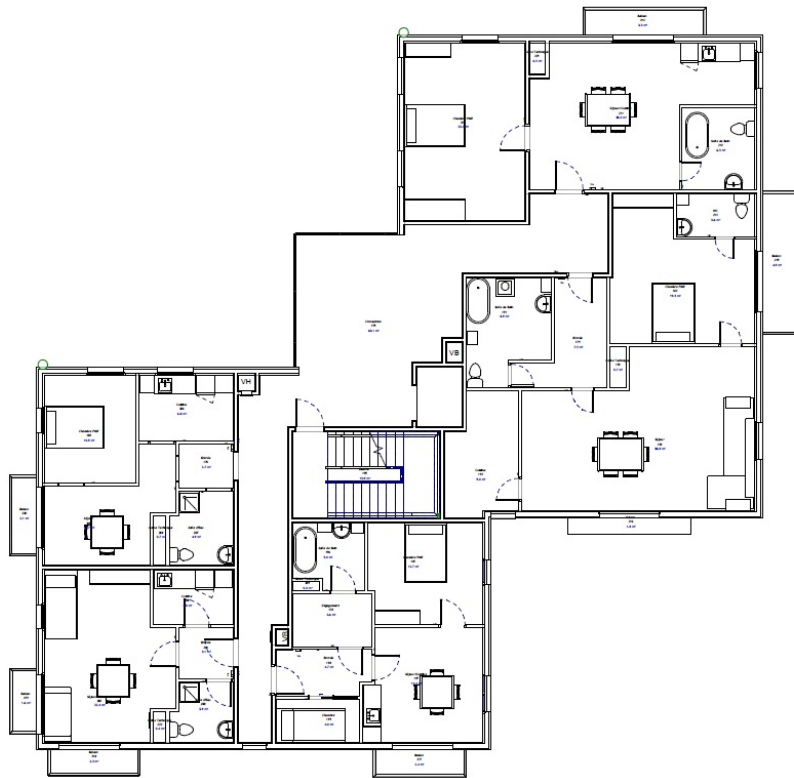
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          "0": {
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                  "polygon": {
                    "y": [
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                      26.55294102700855,
                      26.557841884025027,
                      26.562695543109356,
                      26.567455260871274,
                      26.572075198626806,
                      26.57651086384985,
                      26.58071953865953,
                      26.584660691216733,
                      26.58829636606788,
                      26.59159154967669,
                      26.59451450762368,
                      26.597307090225967,
                      26.599135003634114,
                      26.600788043795163,
                      26.601980291028713,
                      26.60270026334216,
                      26.60294102700855,
                      26.60294102700855,
                      26.60270026334216,
                      26.601980291028713,
```

DeepBIM : CREATING A NEW 3D REPRESENTATION

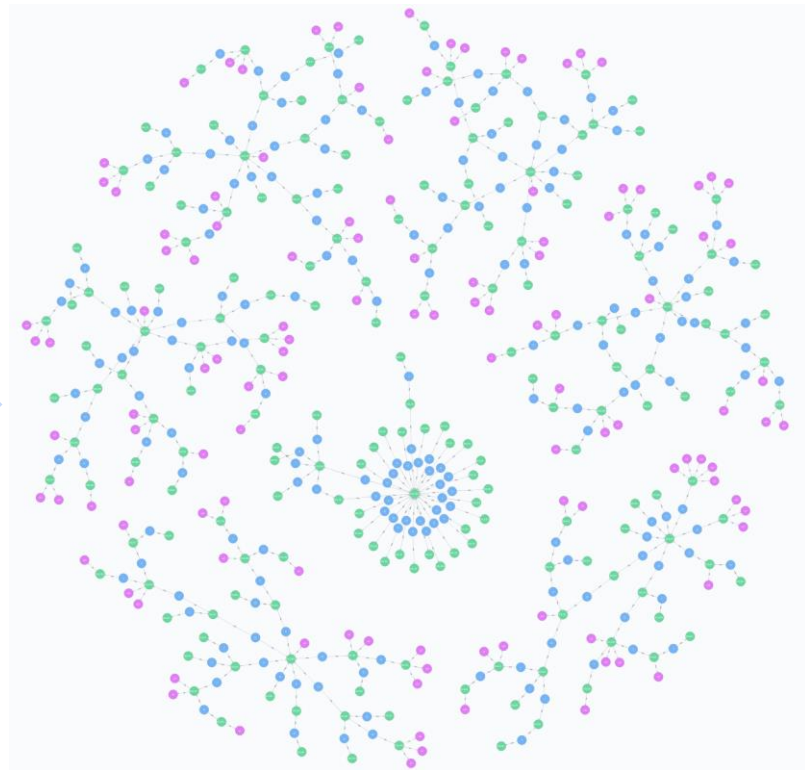
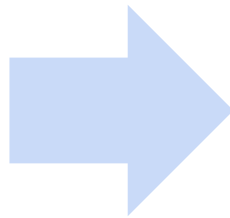


$$T_n(p_n) = p_n \cdot \prod_{i=n-1}^0 M_i + \sum_{j=n-1}^1 O_j \cdot \prod_{k=n-2}^{j-1} M_k, \forall i, j, k \in \mathbb{N}.$$

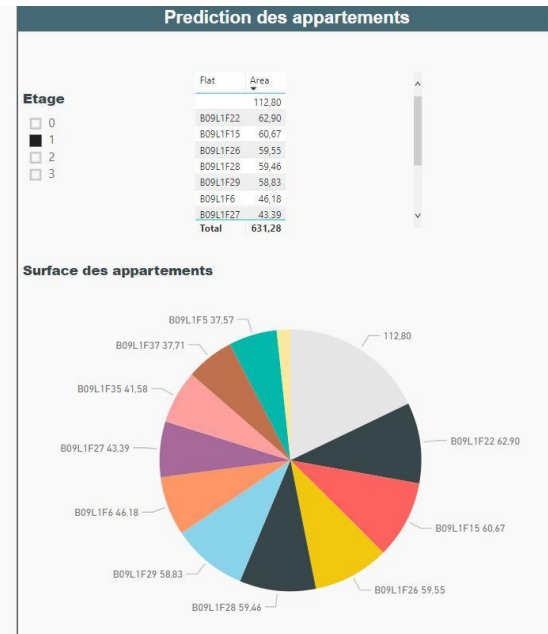
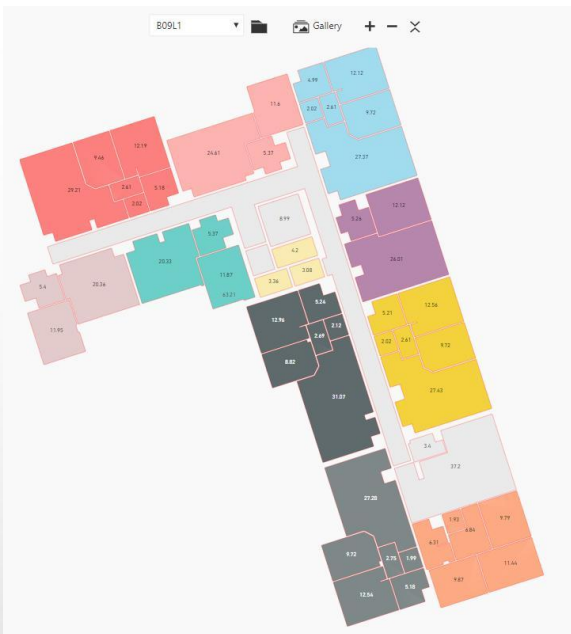
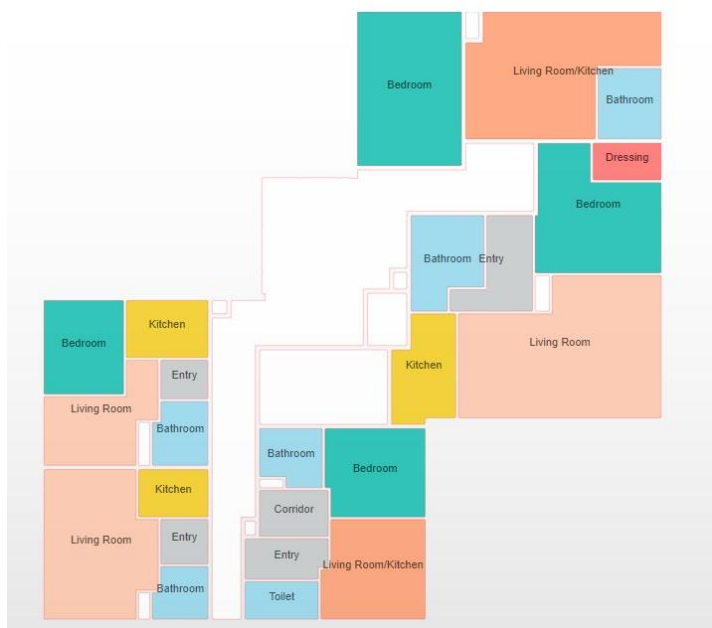
DeepBIM : DETECTING SPACES



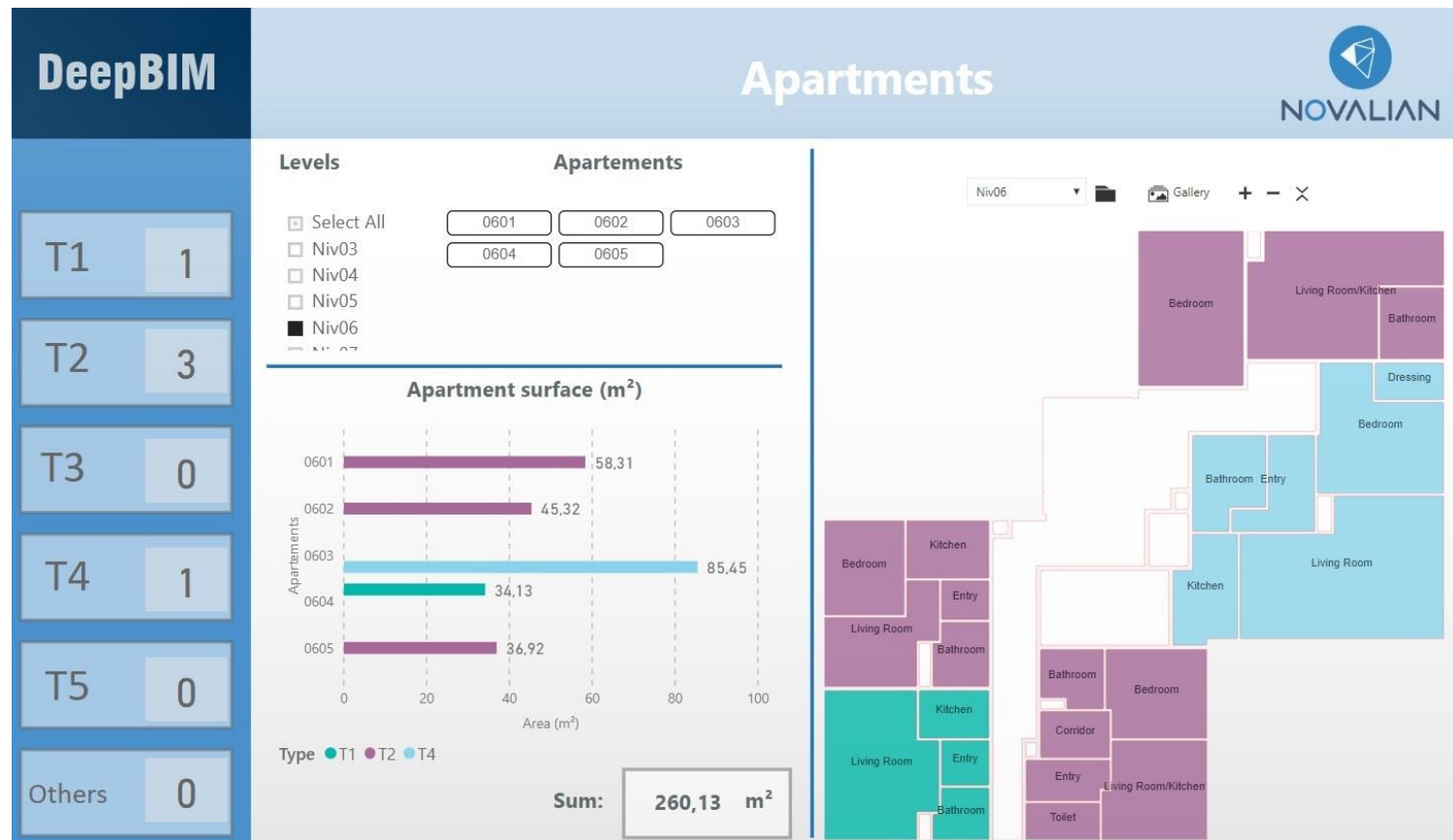
DeepBIM : THE NEW DATA REPRESENTATION



DATA EXPLORATION EXAMPLE



Dashboard example





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Thanks for your attention !

Any questions ?