SEMANTIC ENCODING OF BUILDING REGULATIONS

CONTENTS

- Overall Philosophy and Approach
- The Process of Automating Regulatory Compliance
- Mapping Between Regulations and BIM
- Execution of Regulations
- Future Work

OVERALL PHILOSOPHY

Fully Automated – NLP etc…

- Can regulation experts have confidence in this?

- Automation vs Involvement of regulation experts?
- Role/Involvement of programmers?

Semi Automated Approaches

-Adding metadata required to regulatory documents

-Using this added data to automatically convert to code

Fully Manual – Manual Implementation by programmers…

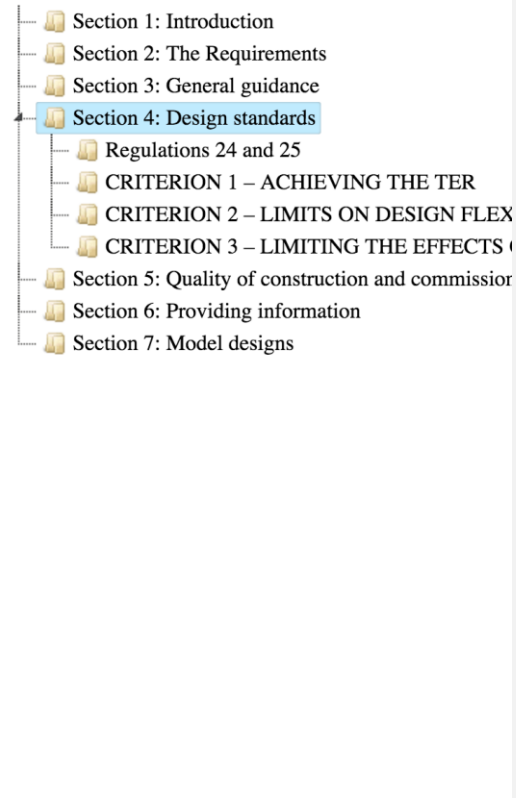
- Can regulation experts have confidence in this?

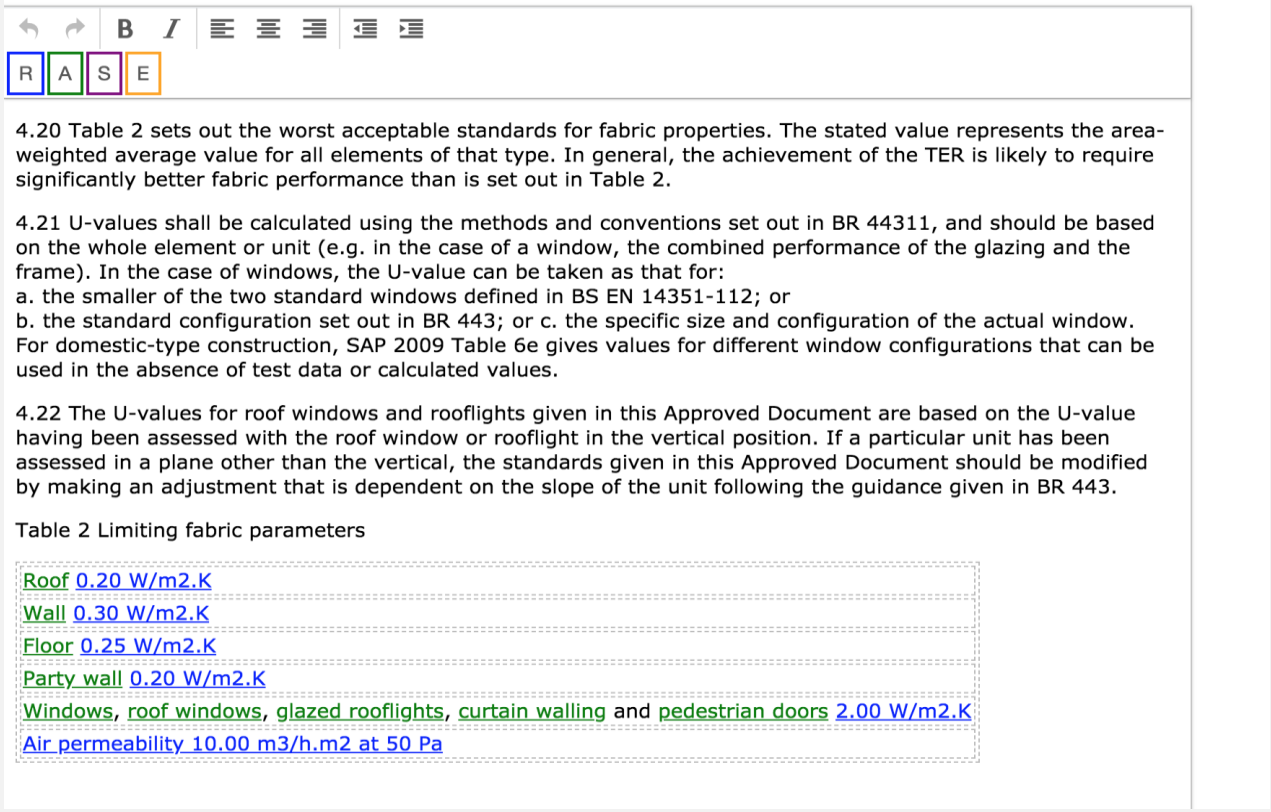
MANAGEMENT OF AUTOMATED REGULATORY COMPLIANCE

- In the future, having a single source from which both human readable, and computer executable code can be generated is the best way to create and, maintain automated regulations checking in the construction sector

AUTOMATING REGULATORY COMPLIANCE

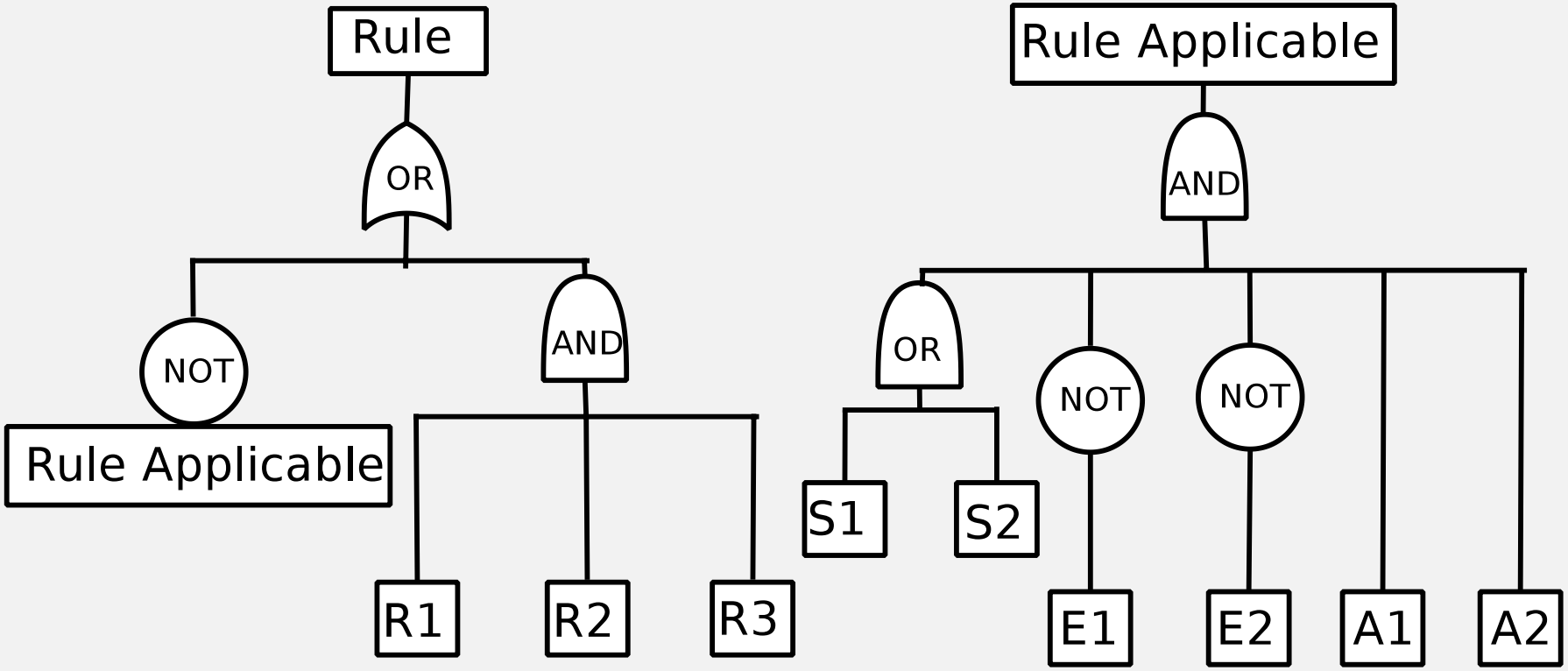
- Step 1: Structure Regulation into a tree like form





- Step 2: Augment with Tags

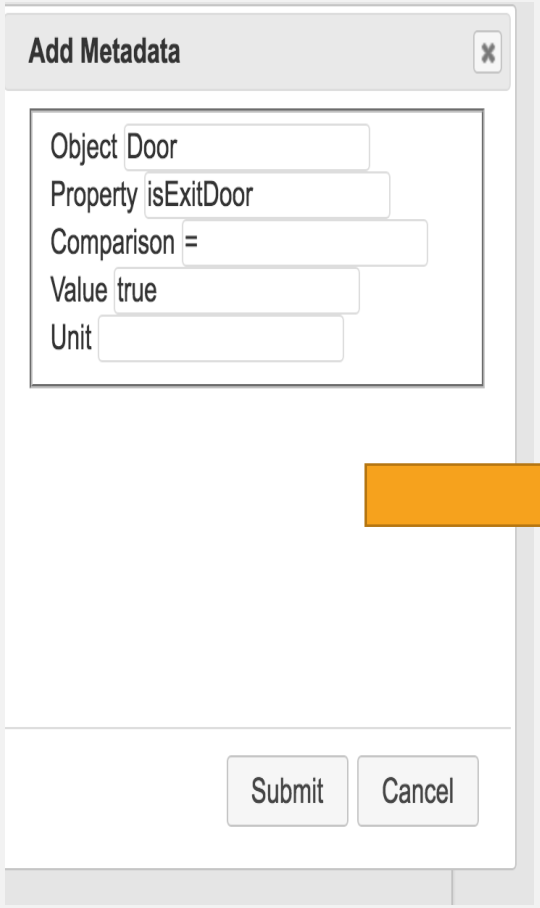
RASE TAGS


Rule
OR
NOT
Rule Applicable
AND
R1
R2
R3
Rule Applicable
AND
OR
S1
S2
NOT
E1
NOT
E2
A1
A2

…..?

- Is a regulation true just because it is not false?
- Is a regulation false because it is not true?
- What about missing data?
- They may be things the design team don't know and thus not data in BIM.
- But what about thinks that they don't know they don't know?

METADATA


Add Metadata
Object Door
Property isExitDoor
Comparison =
Value true
Unit
Submit
Cancel

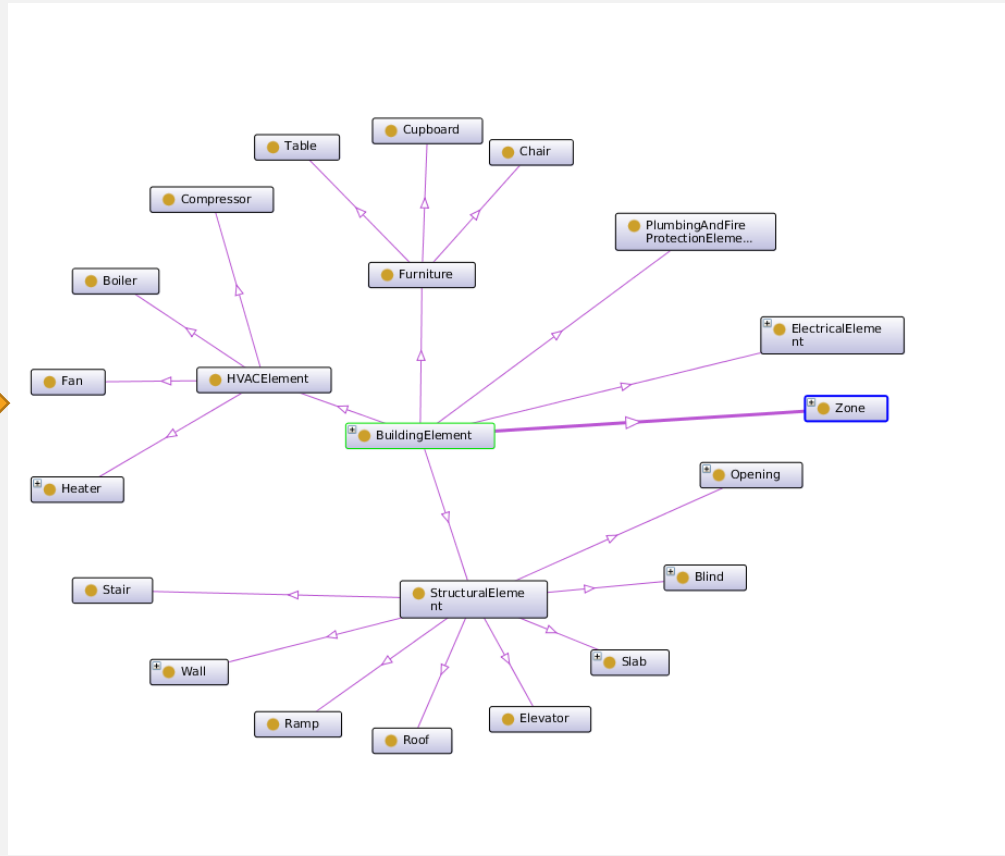
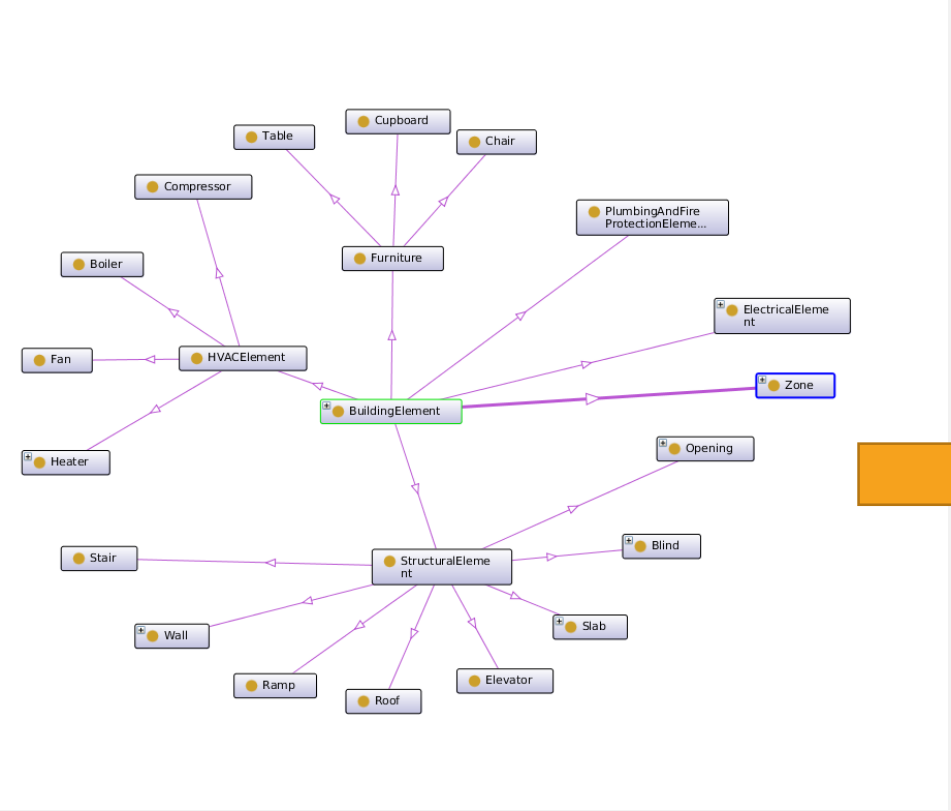


Table
Cupboard
Chair
Compressor
PlumbingAndFire ProtectionEleme...
Boiler
Furniture
ElectricalEleme nt
Fan
HVACElement
Zone
BuildingElement
Heater
Opening
Stair
StructuralEleme nt
Blind
Wall
Slab
Ramp
Roof
Elevator

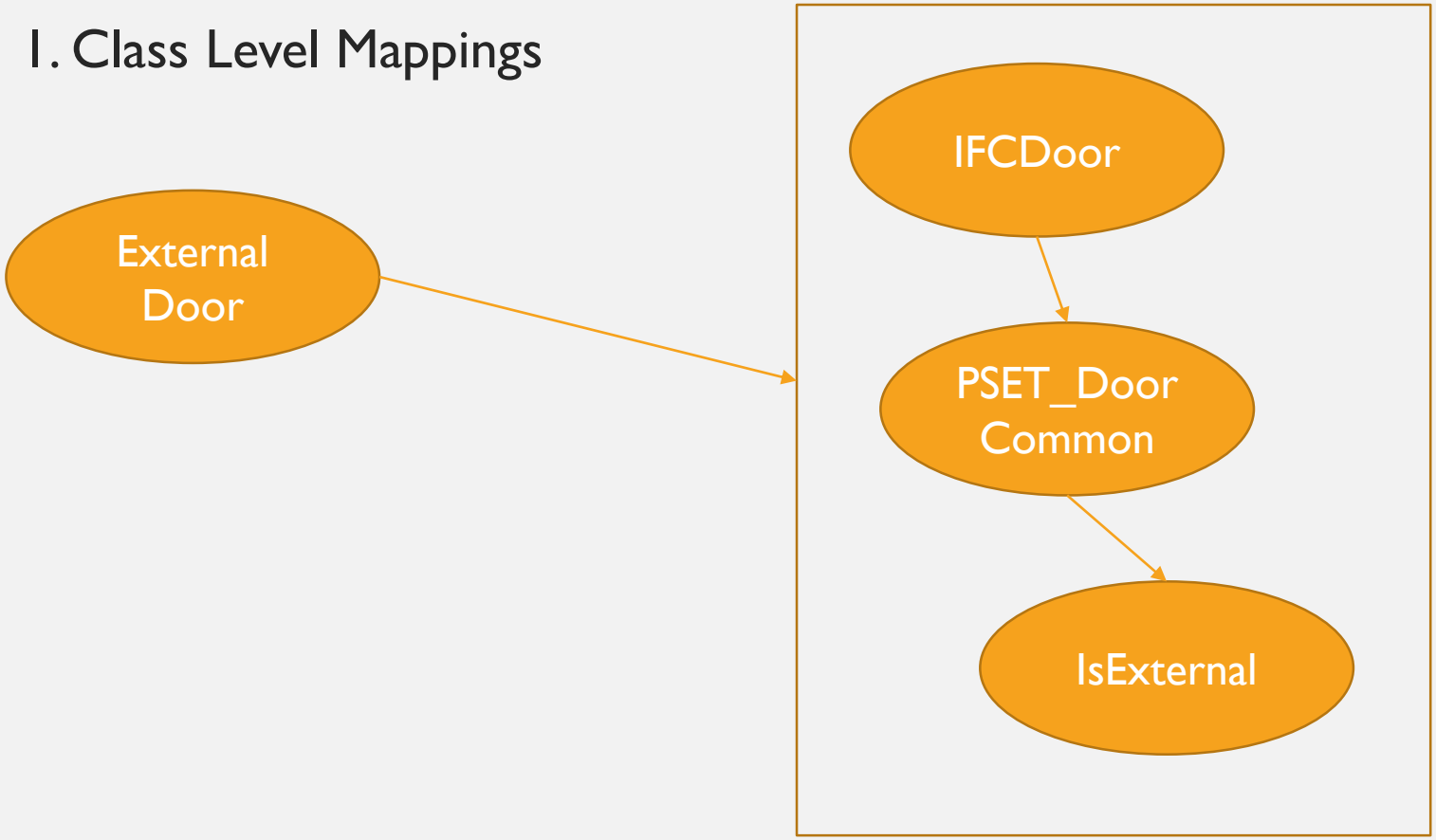
MAPPING TO BIM

- Perhaps the most challenging element!



MAPPING TO BIM

- 1. Class Level Mappings

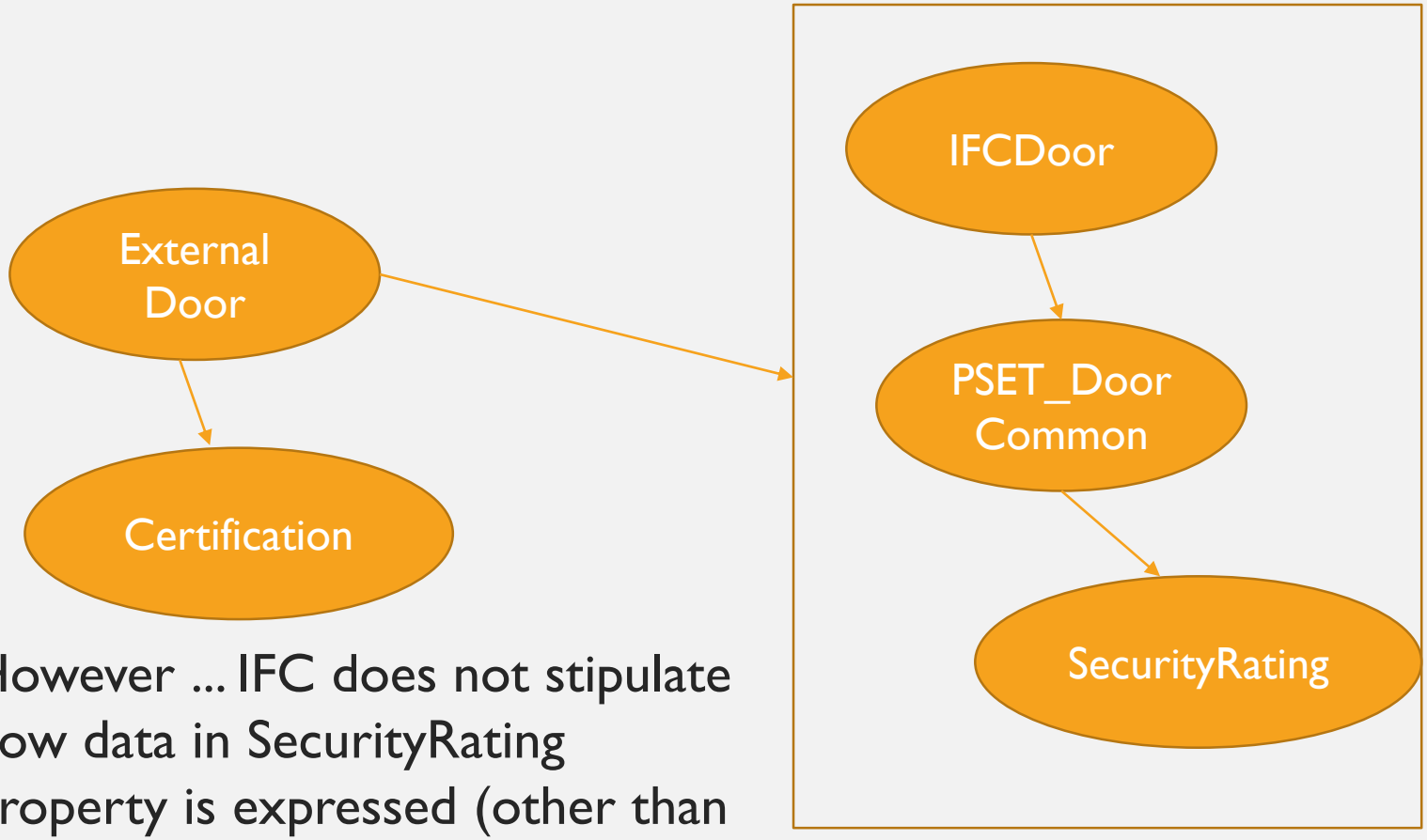


WHY ADOPT SEMANTICS

- V1 – Non Semantic – DRL + Manual Mappings(85%)
- V2 – Semantic – Attempted to model mappings explicitly in semantics defined by me
- V3 – Using SparQL queries – more generic?
- Admittedly I wasn't aware of the LDC conversion work we heard about yesterday
- Also why bother with a regulation ontology? Because regulation experts tend to think in their own language
- Site vs Development Site
- Pool vs Tank(Open Topped?)

MAPPING TO BIM

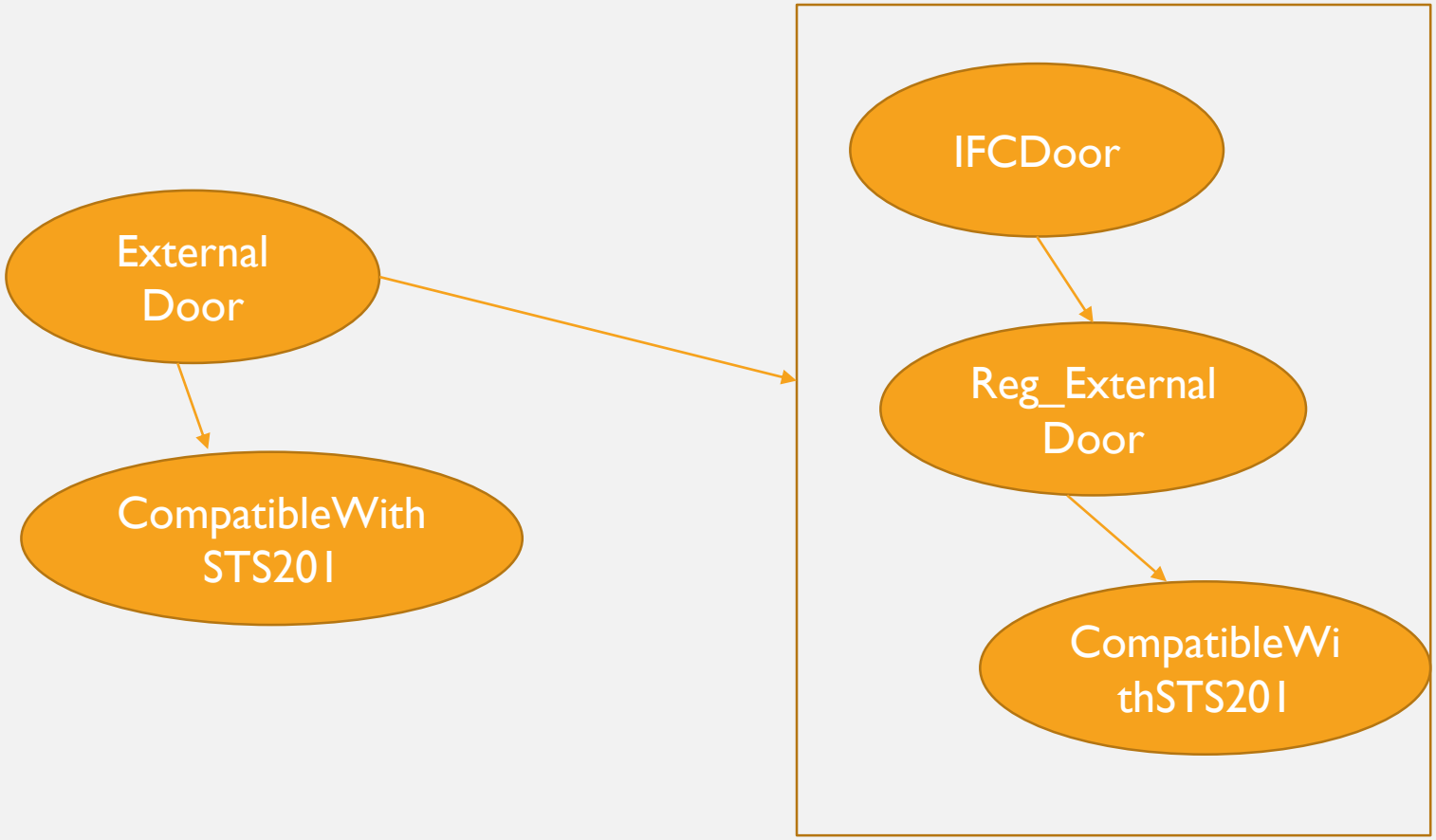
- 2. Property Level Mappings



- However … IFC does not stipulate how data in SecurityRating property is expressed (other than being an index based system)… assumption made

MAPPING TO BIM

- 2. Property Level Mappings (B)

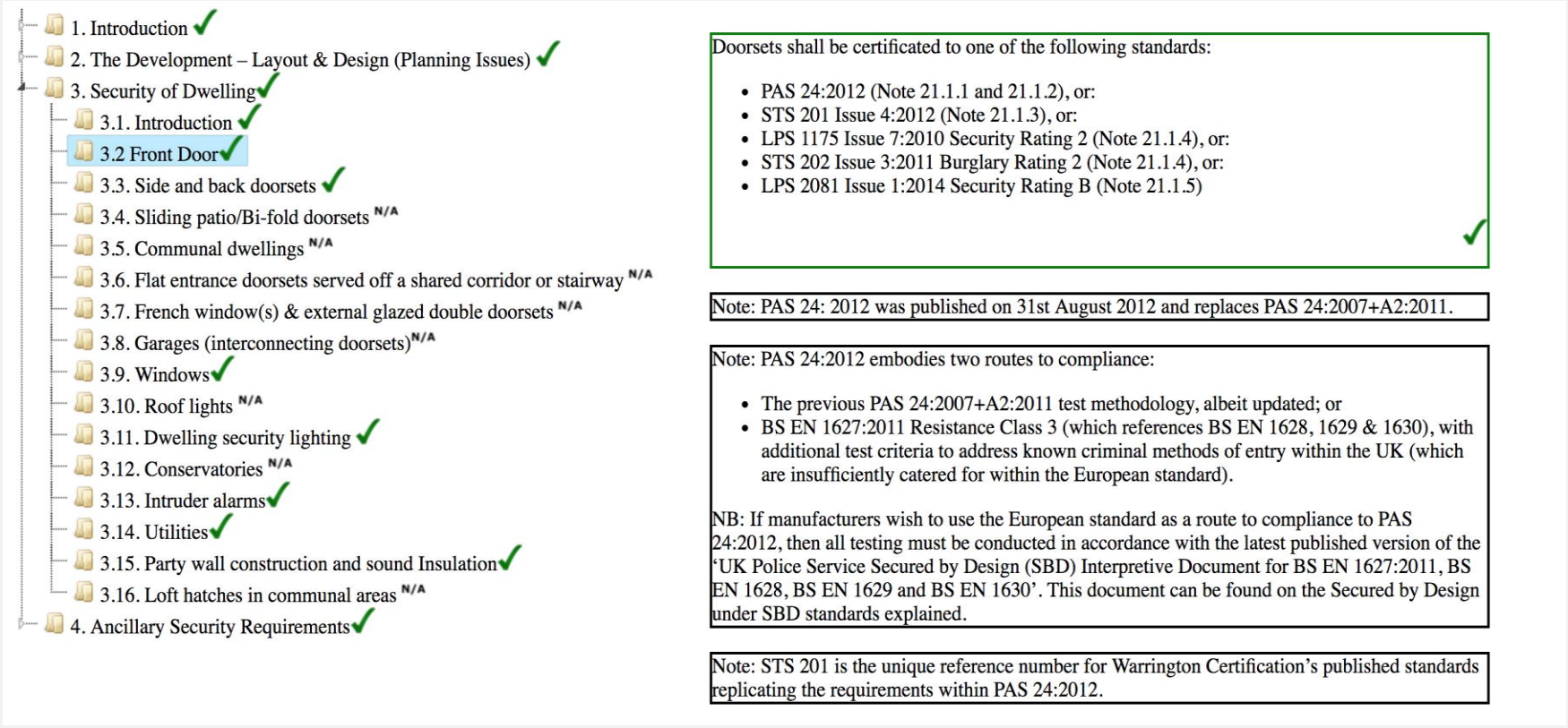


MAPPING TO BIM - PROBLEMS

- A large amount of data needed is often not in the BIM.
- This is because it is either:
  - (a) Calculated from data in the BIM
  - (b) The result of some complex work done by other applications i.e. energy simulations etc…
- We work around (a) by supporting the implementation of procedures specific in a programming language
- Working around (b) is more difficult – we need to marshal data from external applications - this leads to an entire eco-system for compliance checking.
- As a last restore prompts can be raised for user completion.

USE OF SEMANTICALLY ENCODED REGULATIONS

- Generation of human readable documents (using latex).
- Execution (SWRL) Rules



CURRENT CASE STUDIES

- Secured by Design
- Building Regulations
- Secured by Design more prescriptive – thus actually easier to implement
- Building Regulations contain more requirements that require simulation data or complex geometric processing etc….
- Previous work (on a more basic system) also looked at BREEAM.

FUTURE THOUGHTS

- Performance of JENA/SWRL and Pellet reasoner at scale.
- Can complexity of all regulations be modelled by by the tree like structure i.e. BREEAM – or should regulations be rationalised to fit with an explicitly modelled structure?
- Lack of data in BIM models what is solution:
  - Marshal external applications?
  - Perform calculations?
  - Require CAD tools to include data?

D-COM

- I am leading a research network for the UK's centre for digital built Britain (CDBB).
- The topic of this network is on regulatory compliance.
- The D-COM Network will bring together academic and industrial participants to work on the area of automating regulatory compliance. This network will;
  - (a) assessing the current state of the art in the area,
  - (b) gathering requirements from stakeholders,
  - (c) defining, together with industrial and policy making stakeholders, the future pathways for development,
  - (d) defining the capabilities and research required to deliver the defined pathways
  - (e) build a community that can conduct this research and develop capabilities.

ANY QUESTIONS?