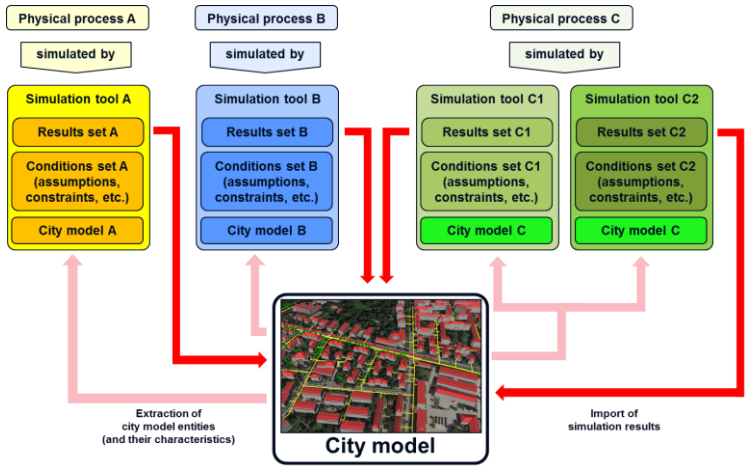
Sneak preview of the Scenario ADE v. 0.2

Giorgio Agugiaro

CityGML Joint Workshop Energy + Utility Network ADE
7 December 2017, Karlsruhe

Smart and Resilient Cities Unit
Center for Energy
AIT - Austrian Institute of Technology
Vienna, Austria



Outlook

- Bridging 3D city modelling & simulation domains (reprise)
  - Refer to previous presentation of Edmund Widl on the "Simulation Package"
- The Scenario ADE
  - Definition and properties
  - UML Diagram
  - 3DCityDB
- Conclusions

Real city

Image source:
https://cdn.austria.info/media/17083/thumbnails/stadtansicht-wien--oesterreich-werbung-julius-silver--d.jpg.3146497.jpg

represented by

"Digital twin"

City model

Physical process A

City model

Physical process A

simulated by

Simulation tool A

City model

Physical process A

simulated by

Simulation tool A

City model A

Extraction of
city model entities
(and their characteristics)

City model

Physical process A

simulated by

Simulation tool A

Conditions set A (assumptions, constraints, etc.)

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City model A

Physical process B

simulated by

Simulation tool B

Results set B

Conditions set B (assumptions, constraints, etc.)

City model B

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Physical process A

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Physical process B

simulated by

Simulation tool B

Results set B

Conditions set B (assumptions, constraints, etc.)

City model B

Physical process C

simulated by

Simulation tool C1

Results set C1

Conditions set C1 (assumptions, constraints, etc.)

City model C

Simulation tool C2

Results set C2

Conditions set C2 (assumptions, constraints, etc.)

City model C

City model

Extraction of
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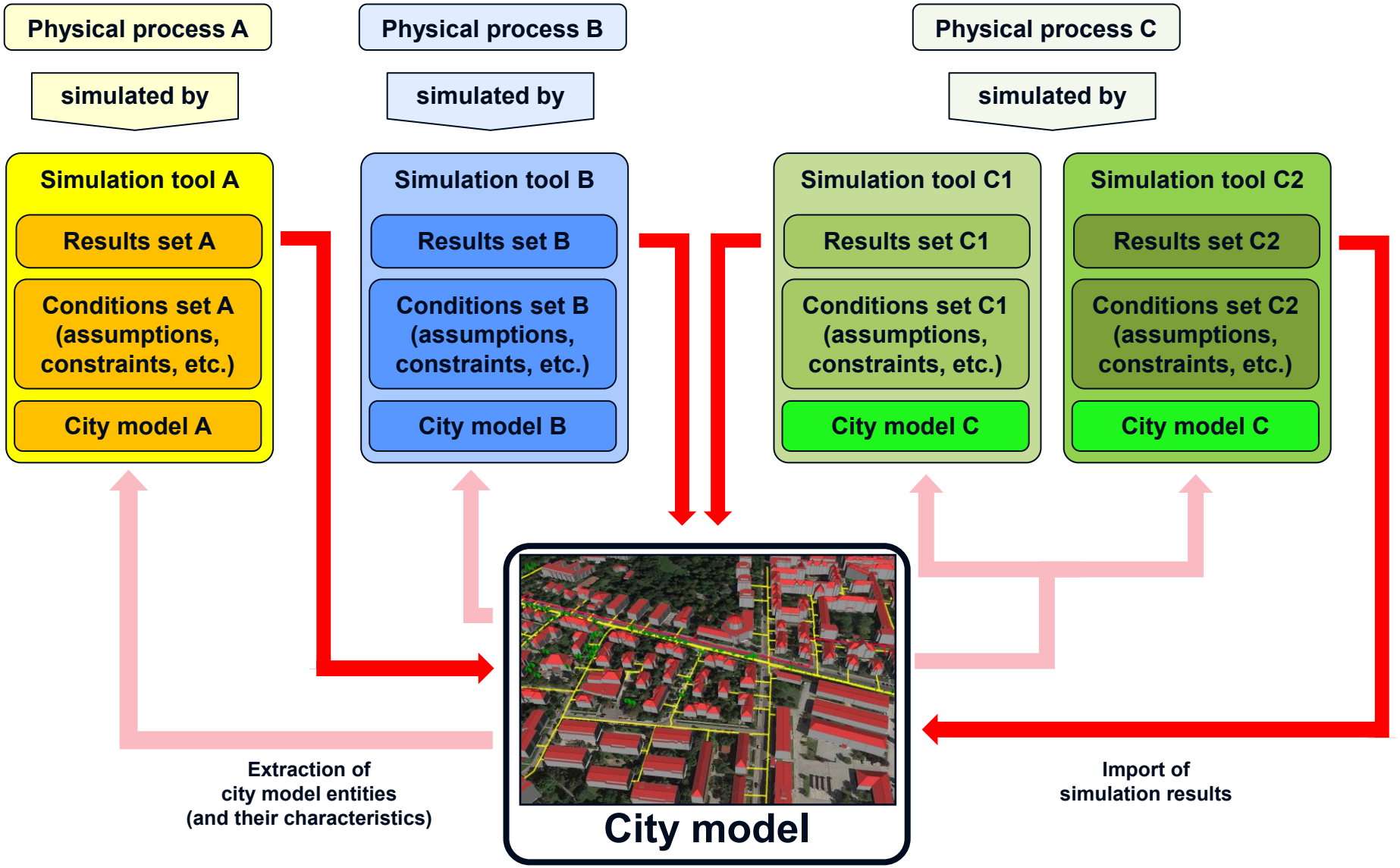
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simulated by
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Simulation tool C2
Results set C2
Conditions set C2 (assumptions, constraints, etc.)
City model C
City model
Extraction of city model entities (and their characteristics)
Import of simulation results

PROBLEM:

Which set of results is "better"?

Storing "just" the results <u>may</u> not be enough!

Physical process C

simulated by

Simulation tool C1	Simulation tool C2
Results set C1	Results set C2
Conditions set C1 (assumptions, constraints, etc.)	Conditions set C2 (assumptions, constraints, etc.)
City model C	City model C

City model

Import of simulation results

Extraction of city model entities (and their characteristics)

Deriving new city models

- A city is a "living" system which continuously changes over time
- A virtual city model is a snapshot at a certain moment

City model

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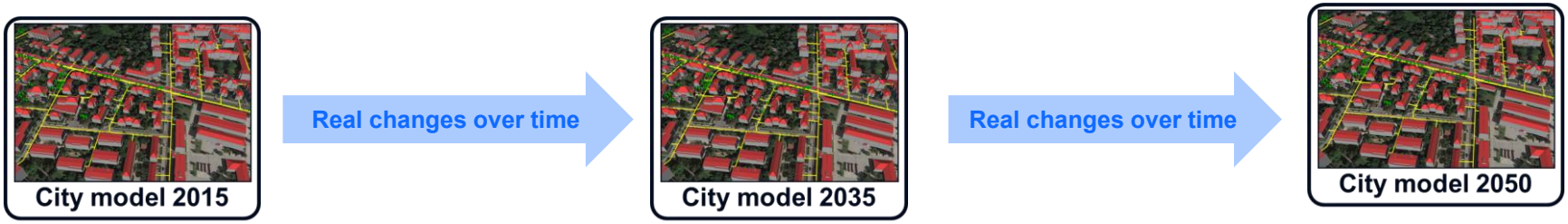
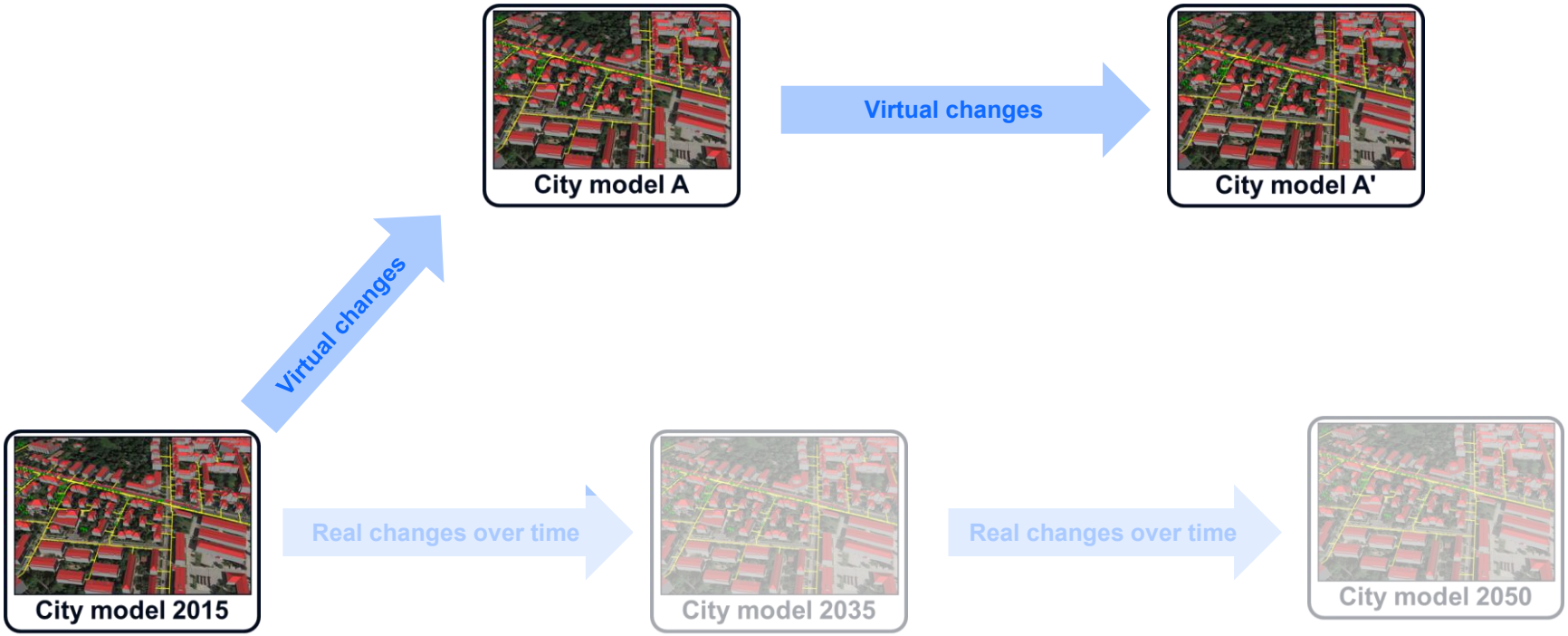


These progressive time-dependent changes can be taken care of by means of versioning

Deriving new city models

- A city is a "living" system which continuously changes over time
- A virtual city model is a snapshot at a certain moment
- But, as digital twin, it can be also *manipulated* at will! ☺



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Scenario ADE: Rationale

- A city is a "living" organism: it continuously changes over time
- A city model is a snapshot at a certain instant
- But, as "*digital twin*", it can be also changed at will! ☺

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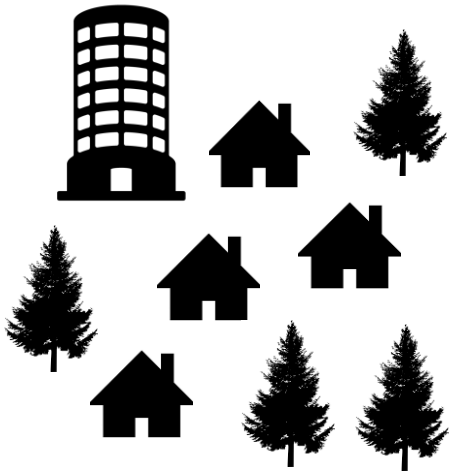
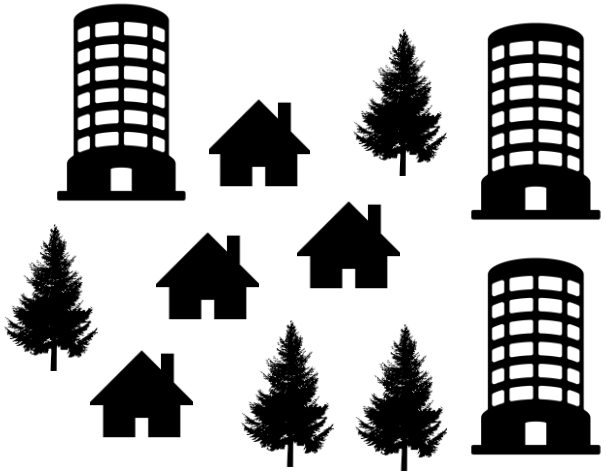
Deriving "new" city models: basic operations



Source city model

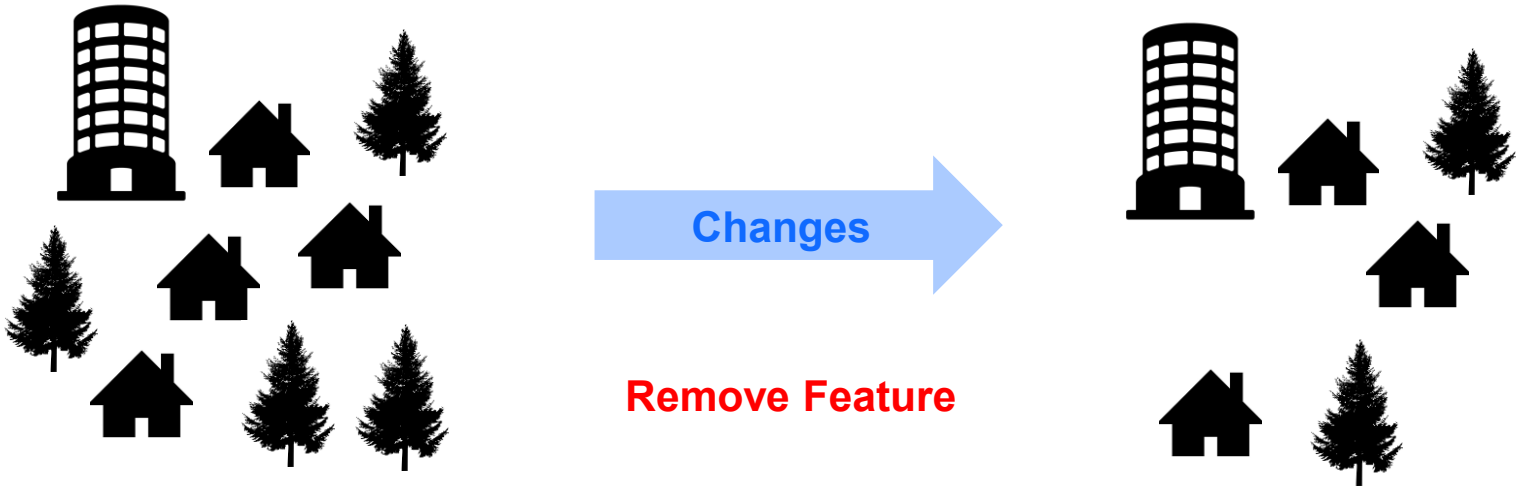
Changes

Add Feature



City model A

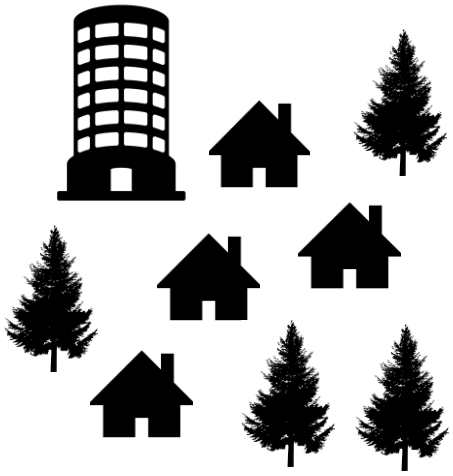
Deriving "new" city models: basic operations



Source city model

City model B

Deriving "new" city models: basic operations



Change Feature Attribute

Source city model

City model C

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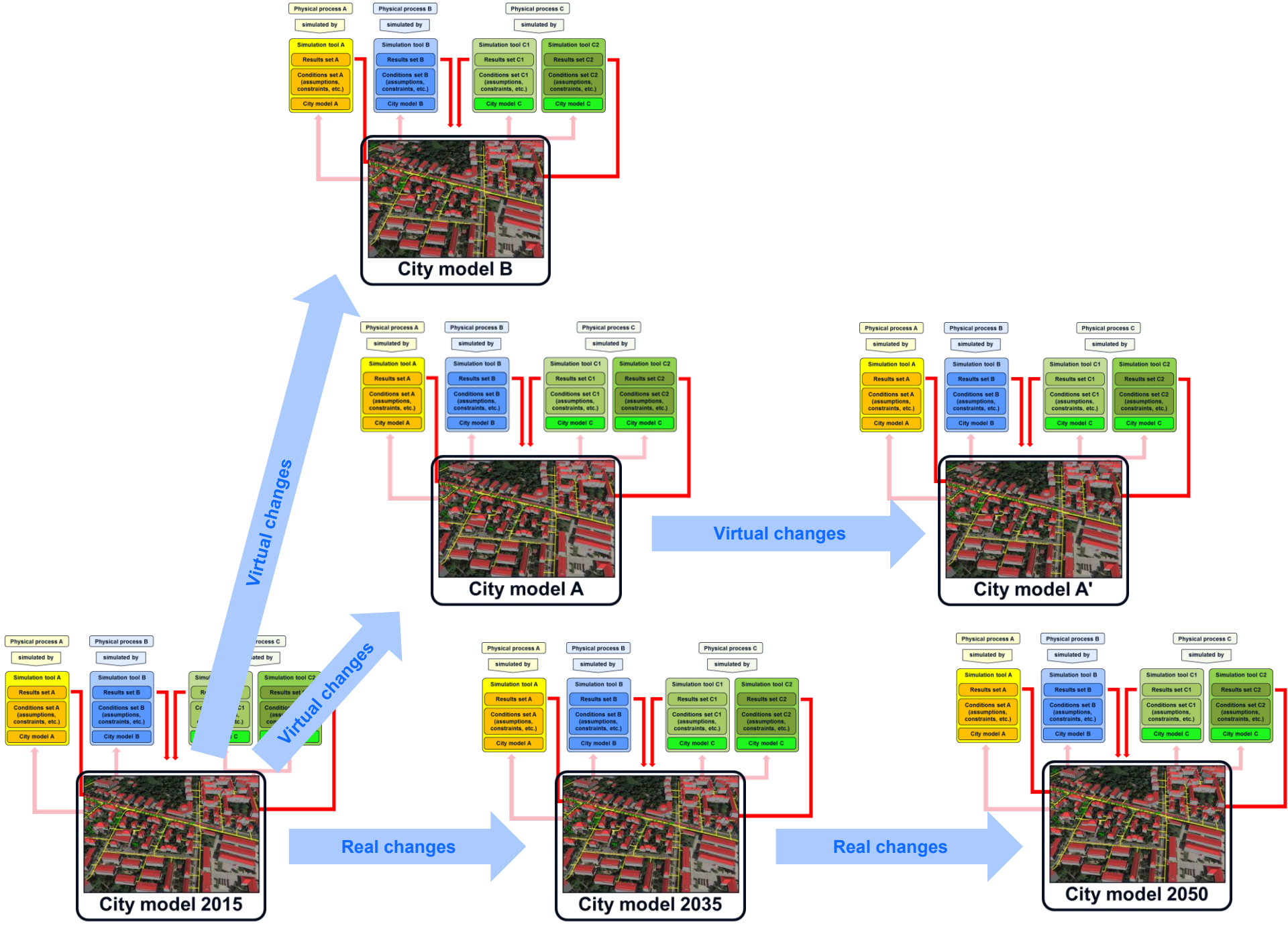
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City model C
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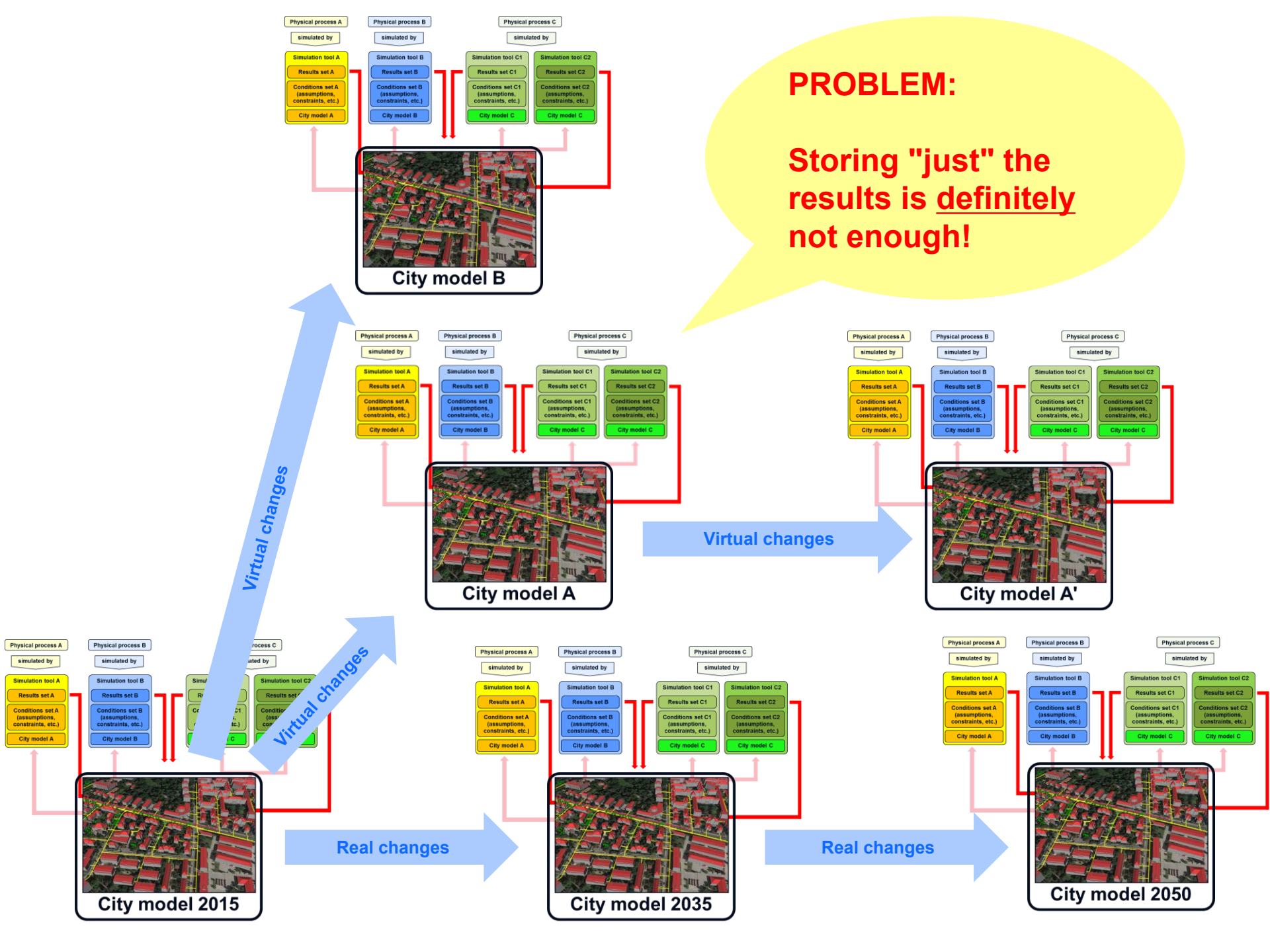
Virtual changes
City model A
Virtual changes
City model A'
Virtual changes
City model 2015
Real changes
City model 2035
Real changes
City model 2050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Virtual changes
Virtual changes
Virtual changes
Real changes
Real changes

(Some) related work

- Chaturvedi K. et al. (2015), "**Managing versions and history within semantic 3D city mode for the next generation of CityGML**"
  - Oriented at CityGML 3.0
  - A rather profound change/addition to the current CityGML model
  - http://mediatum.ub.tum.de/doc/1276238/1276238.pdf

- Sindram M. (PhD in preparation) "**Modeling of Urban Planning Actions by Complex Transactions on Semantic 3D City Models**"
  - Work in progress paper (2014): http://www.iemss.org/sites/iemss2014/papers/iemss2014_submission_225.pdf

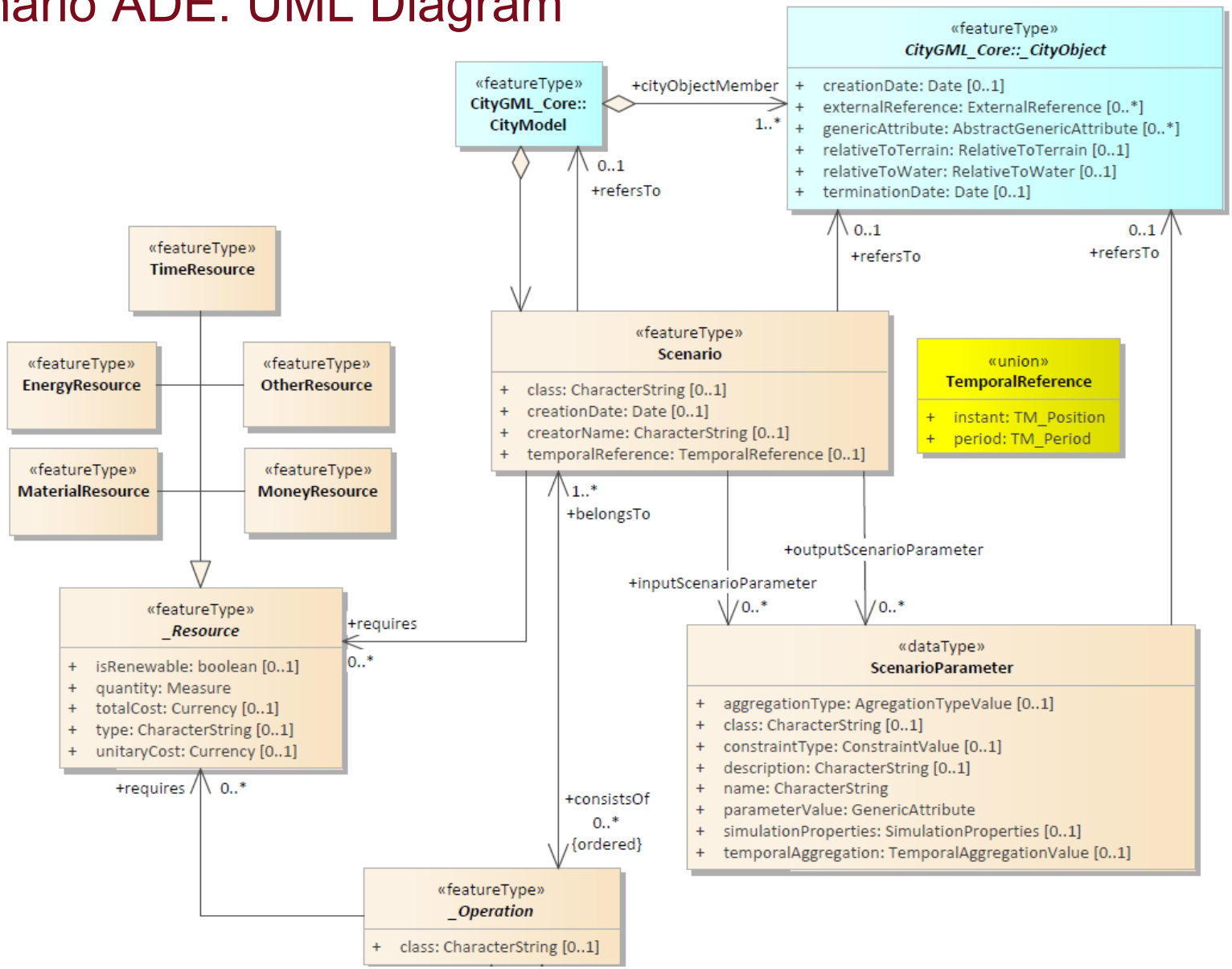
- Benner J. (2017) "**Proposal to Store Energy Simulation results / inputs in the Energy ADE**" (Presentation at Energy ADE Workshop)
  - http://en.wiki.energy.sig3d.org/images/upload/KIT-Proposals-EnergyADE.pdf

- Several **bilateral discussions** with colleagues
  - IF any, then home-made, specific solutions
  - No detailed information, documentation, code, etc.

Scenario ADE: Rationale

- In the Scenario ADE, a **scenario** is defined as a unique combination of:
  - A **city model** (a building, a district, …, the whole city)
    - Information about how the city model (virtual or real) was obtained
      - Description of changes from city model A to city model B
  - A **simulation tool/model** characterised by a set of conditions:
    - Specific assumptions
    - Specific constraints
  - The set of **results**, (KPIs, time series, …)
    - possibly having different spatial and temporal resolutions
    - possibly linked to specific entities (CityObjects)
  - A scenario is the **connection** point between the Simulation Package and the/a city model.

Scenario ADE: UML Diagram



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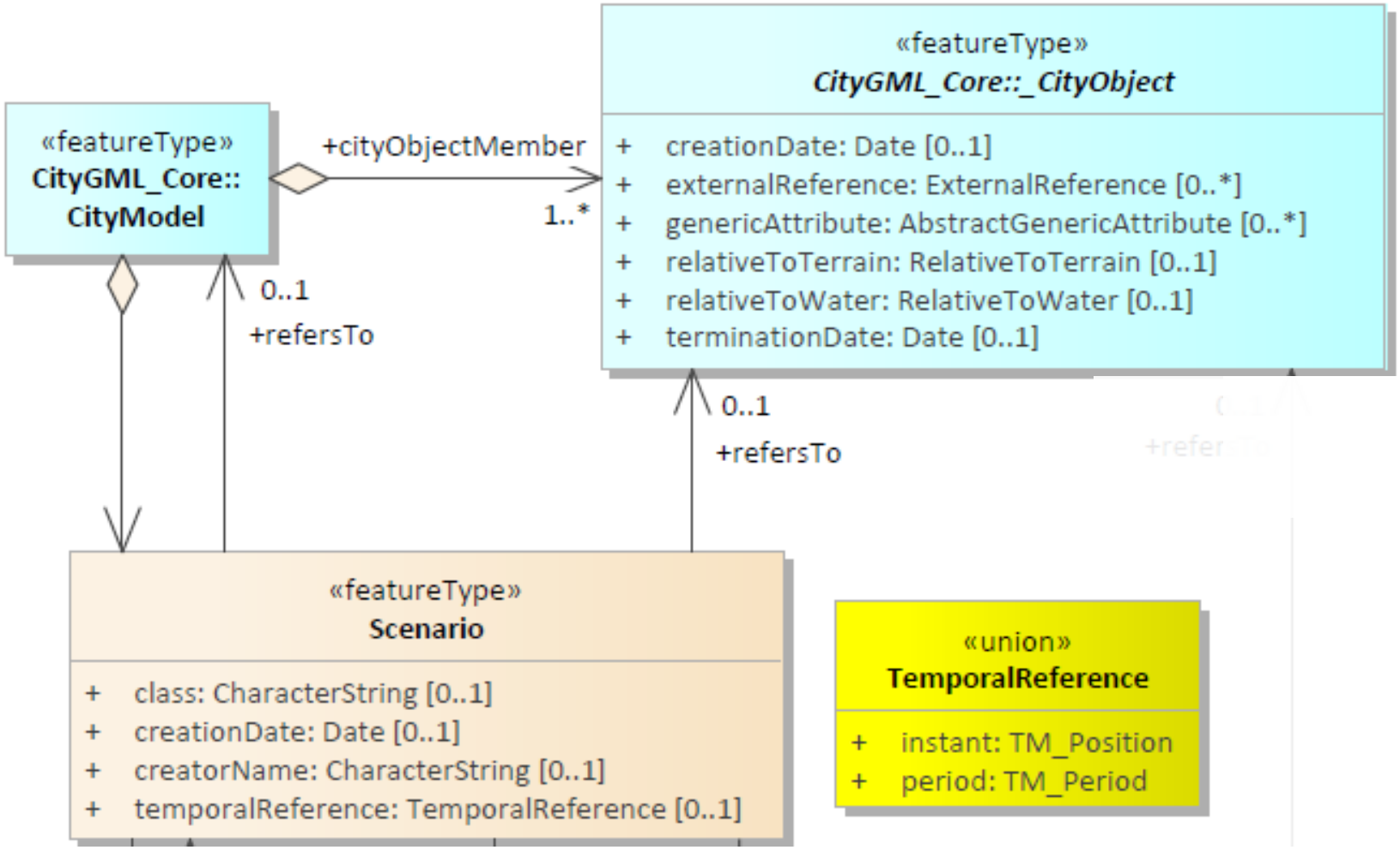

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+ terminationDate: Date [0..1]

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+refersTo

0..1

+refersTo

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TemporalReference

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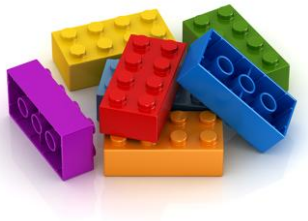

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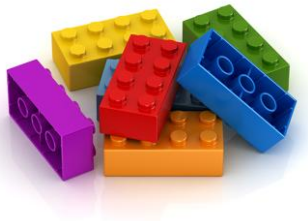

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Source of Lego Images: http::/www.lego.com

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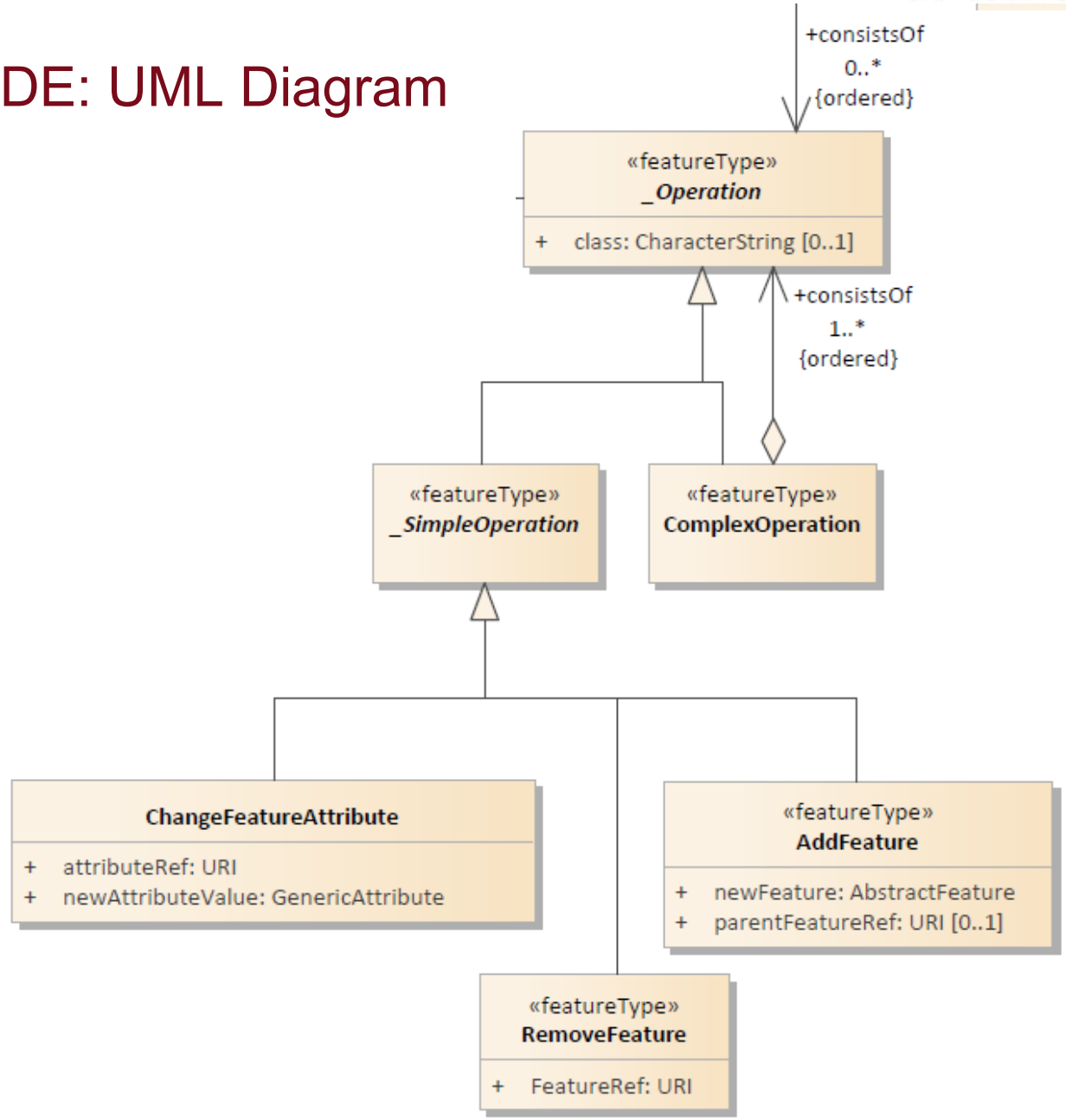

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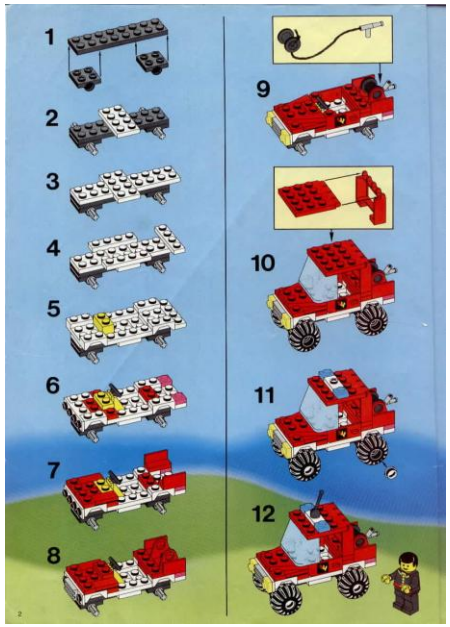

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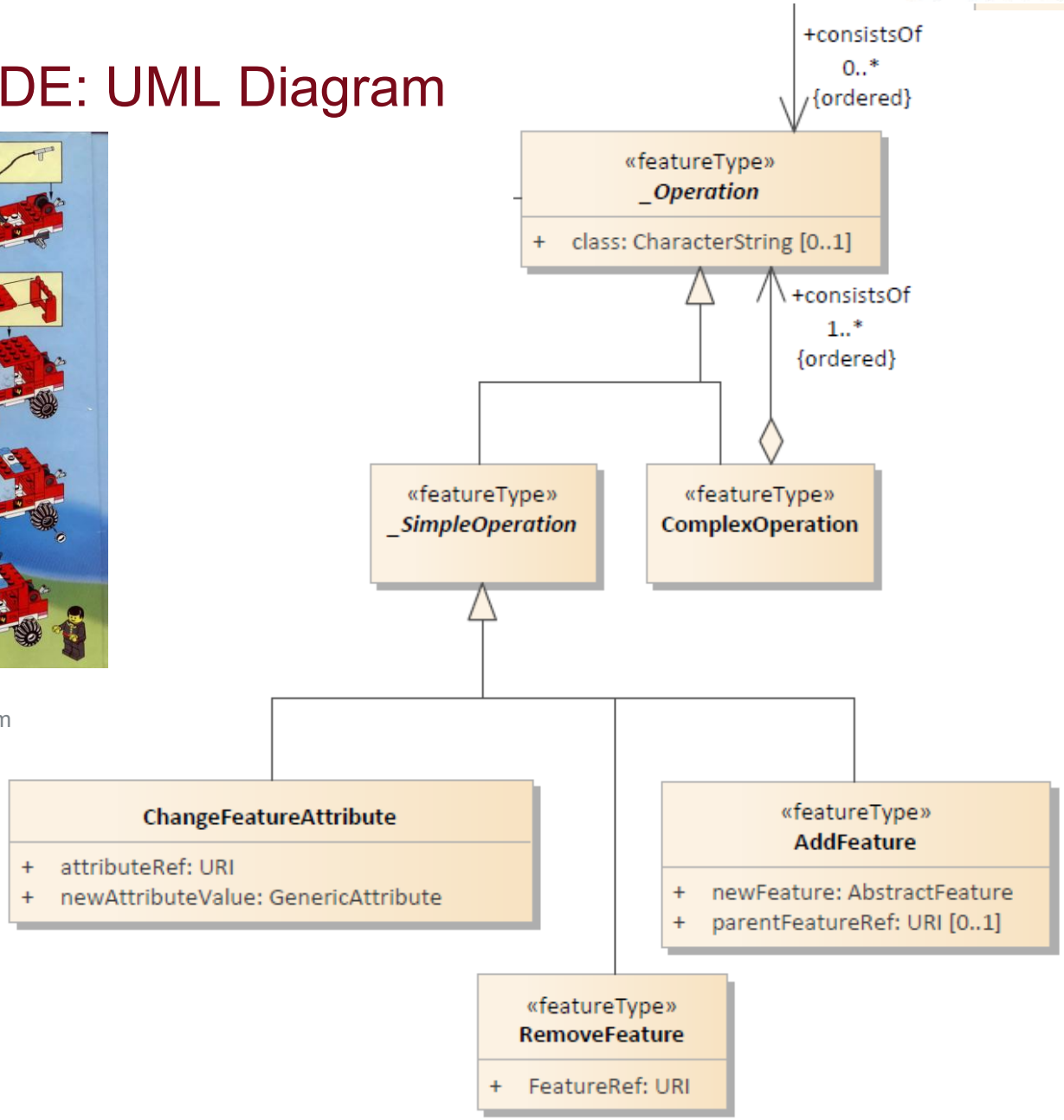

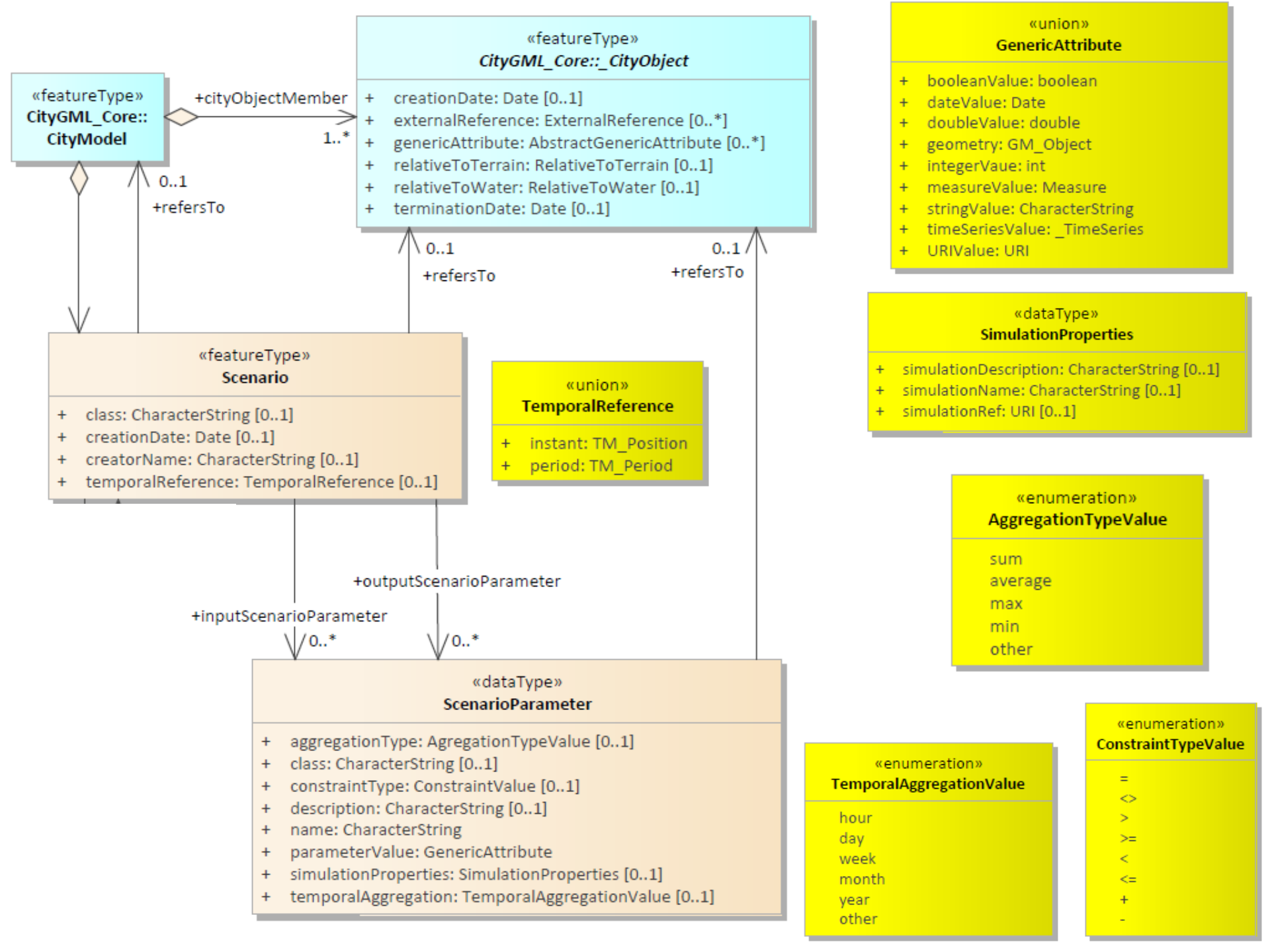
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+ terminationDate: Date [0..1]
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+ doubleValue: double
+ geometry: GM_Object
+ integerVaue: int
+ measureValue: Measure
+ stringValue: CharacterString
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+ URIValue: URI
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+refersTo
0..1
+refersTo
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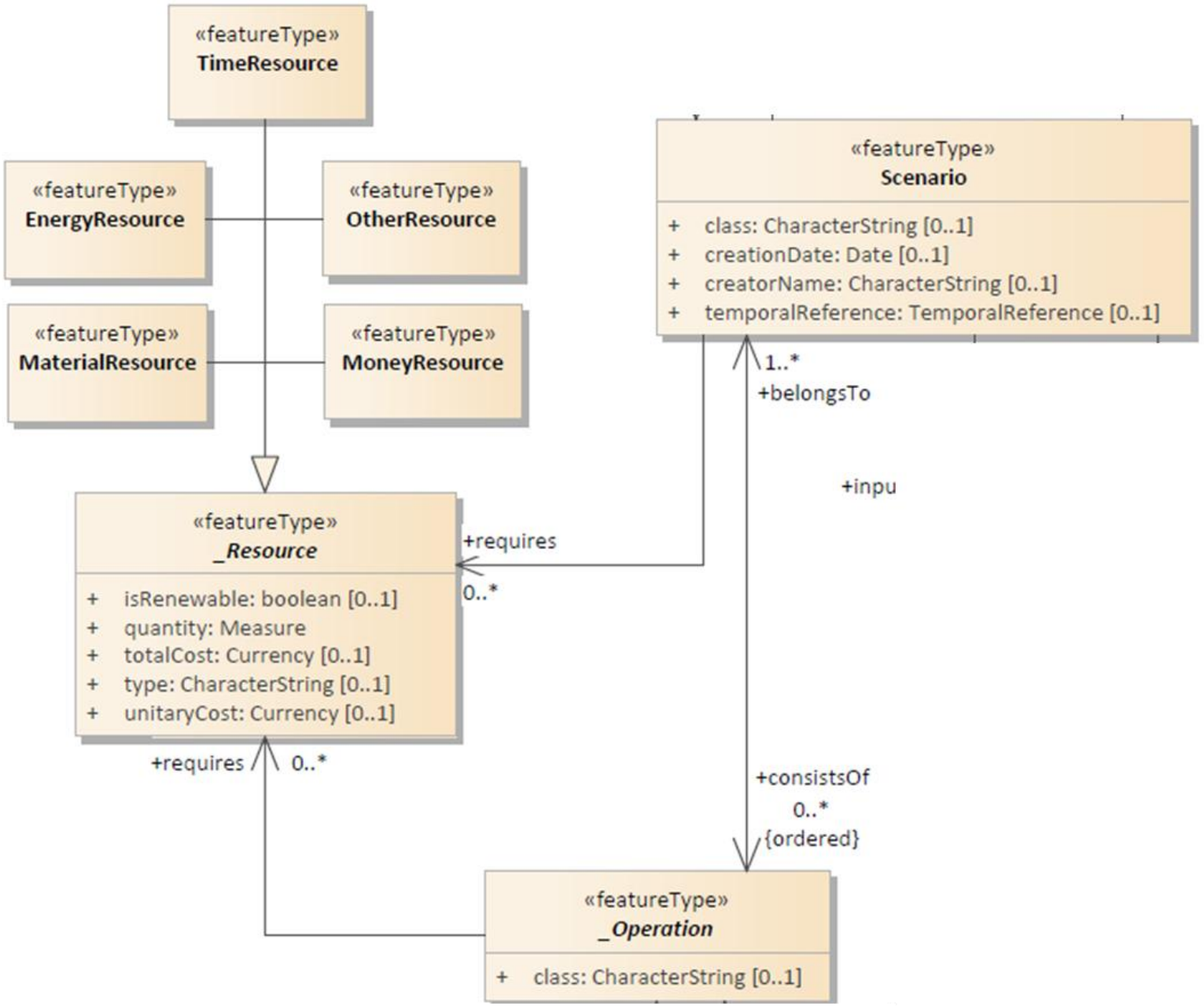
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+inpu
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0..*
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0..*
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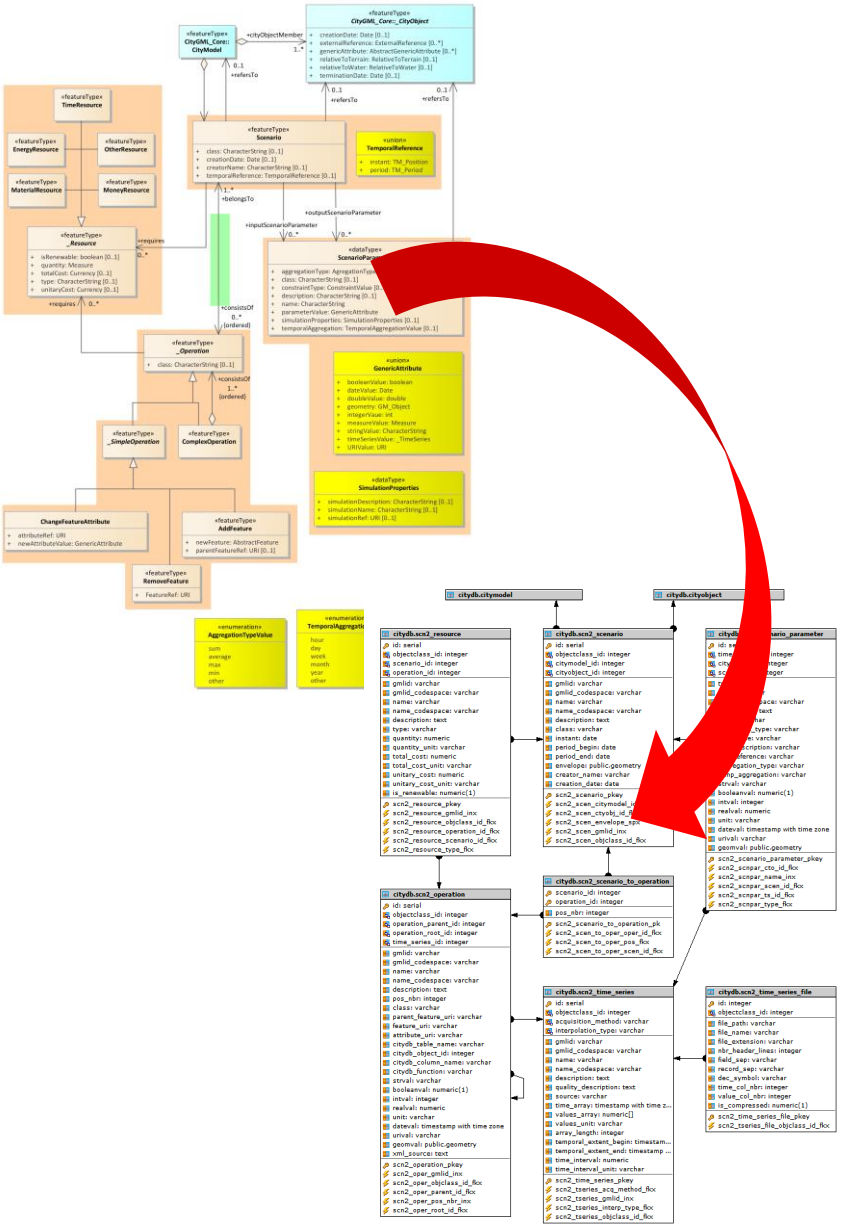
Scenario ADE & 3DCityDB

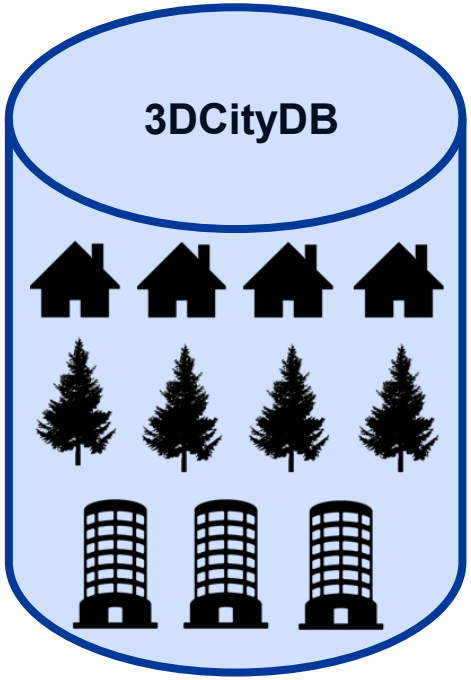
- Already implemented as database schema and included in the extended 3DCityDB "plus"
- Implementation rules are exactly the same as for Energy ADE and Utility Network ADE

→ See next presentation



Scenario ADE & 3DCityDB

- Basic idea: **avoid "cloning"** objects used in multiple city models
  - Store (City)Objects only once in one db instance, and use different grouping rules



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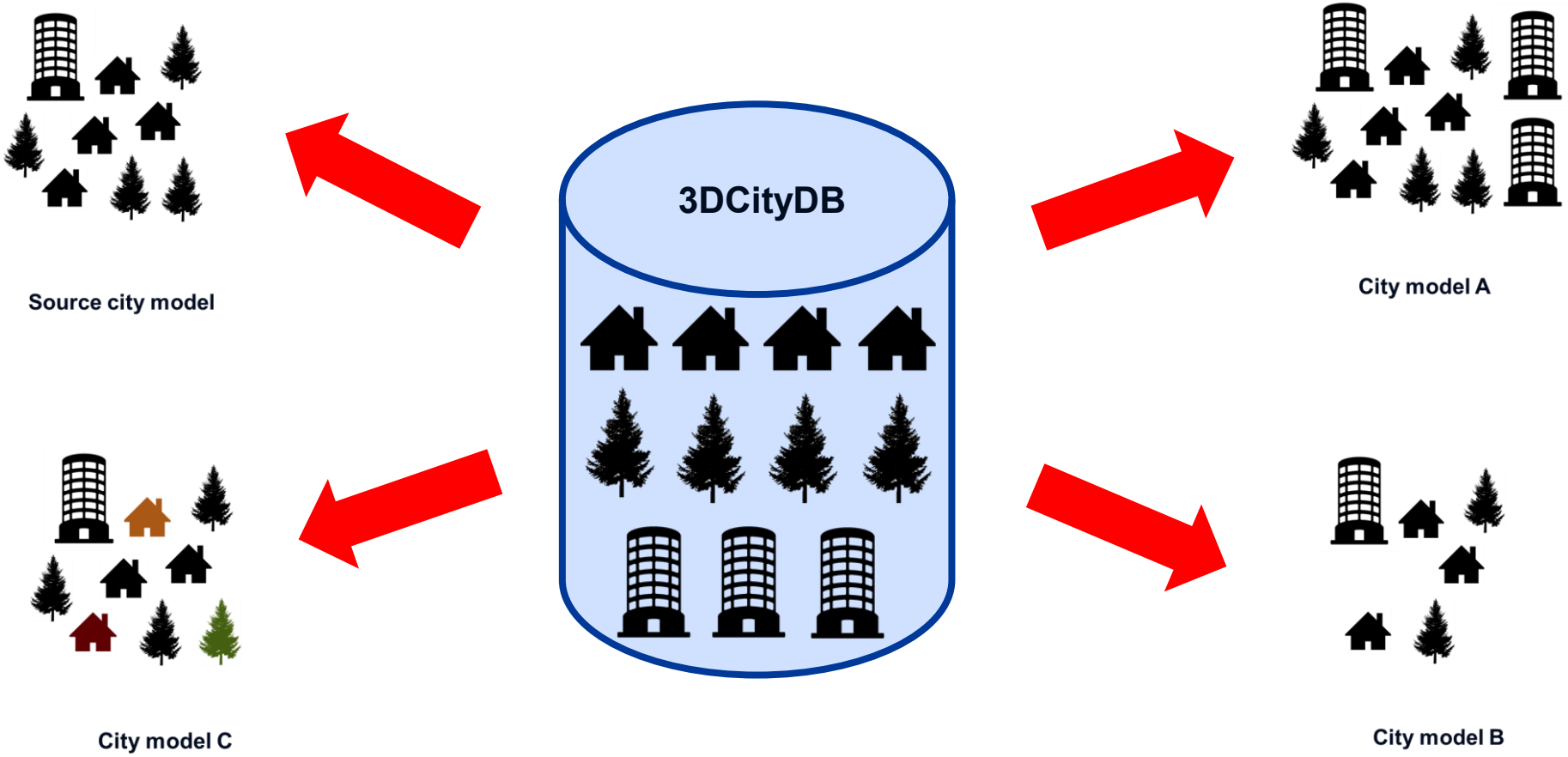

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- The **GOOD NEWS:**
  - The 3DCityDB already has tables allowing it
    - CITYMODEL table
    - CITYOBJECT_MEMBER table
  - Currently unused (for a number of reasons) by the Importer/Exporter, but they can be used by interacting directly with the 3DCityDB

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- **BUT**:
  - The Importer/Exporter tools does not support handling of multiple city models in the same database instance
  - Some workarounds are necessary to import and export (e.g. *"ab"using* a bit the concept of CityObjectGroup)

Conclusions

- The current Scenario ADE (v. 0.2!!)
  - gives a (relatively simple and lightweight) answer to the general need of scenario management within virtual city models
  - Contributes to bridging the "city modelling" and "simulation" worlds
    - The link is the Scenario, not the CityModel itself
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    - It allows for documentation of "how a city model was obtained"
  - It is compatible with the current CityGML 2.0
  - It exploits already existing objects of the 3DCityDB
    - Already implemented for the 3DCityDB
    - BUT some limitations in terms of Importer/Exporter
  - Already being used and tested within project IntegrCiTy

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    - Are you interested at deeper look?
    - Willing to use it? Willing to contribute?
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CONTACT US!!

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your ingenious partner

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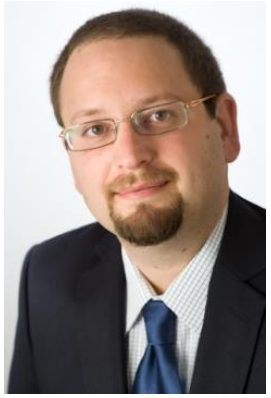

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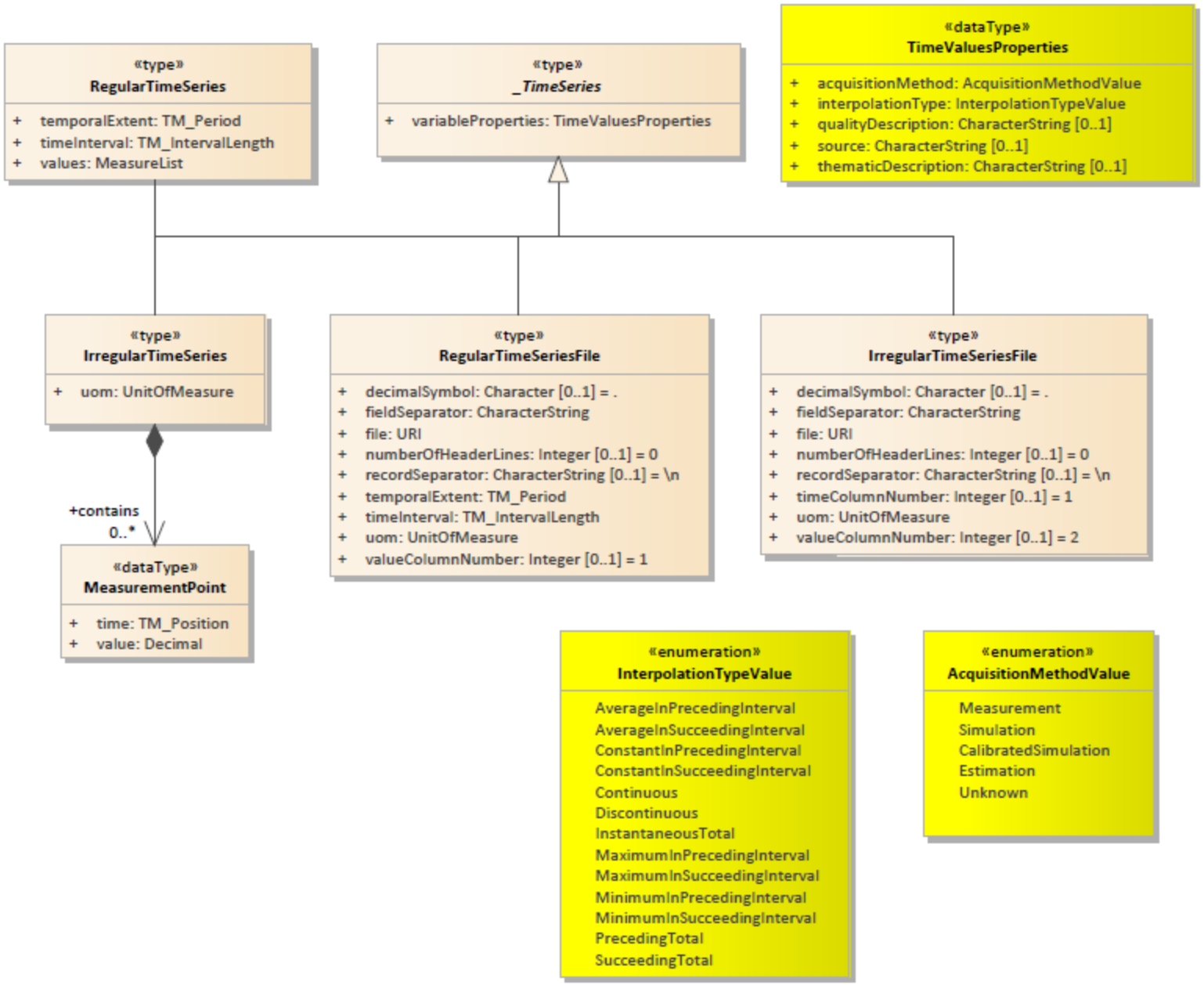
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RegularTimeSeries
+ temporalExtent: TM_Period
+ timeInterval: TM_IntervalLength
+ values: MeasureList
«type»
_TimeSeries
+ variableProperties: TimeValuesProperties
«dataType»
TimeValuesProperties
+ acquisitionMethod: AcquisitionMethodValue
+ interpolationType: InterpolationTypeValue
+ qualityDescription: CharacterString [0..1]
+ source: CharacterString [0..1]
+ thematicDescription: CharacterString [0..1]
«type»
IrregularTimeSeries
+ uom: UnitOfMeasure
+contains
0..*
«dataType»
MeasurementPoint
+ time: TM_Position
+ value: Decimal
«type»
RegularTimeSeriesFile
+ decimalSymbol: Character [0..1] = .
+ fieldSeparator: CharacterString
+ file: URI
+ numberOfHeaderLines: Integer [0..1] = 0
+ recordSeparator: CharacterString [0..1] = \n
+ temporalExtent: TM_Period
+ timeInterval: TM_IntervalLength
+ uom: UnitOfMeasure
+ valueColumnNumber: Integer [0..1] = 1
«type»
IrregularTimeSeriesFile
+ decimalSymbol: Character [0..1] = .
+ fieldSeparator: CharacterString
+ file: URI
+ numberOfHeaderLines: Integer [0..1] = 0
+ recordSeparator: CharacterString [0..1] = \n
+ timeColumnNumber: Integer [0..1] = 1
+ uom: UnitOfMeasure
+ valueColumnNumber: Integer [0..1] = 2
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InterpolationTypeValue
AverageInPrecedingInterval
AverageInSucceedingInterval
ConstantInPrecedingInterval
ConstantInSucceedingInterval
Continuous
Discontinuous
InstantaneousTotal
MaximumInPrecedingInterval
MaximumInSucceedingInterval
MinimumInPrecedingInterval
MinimumInSucceedingInterval
PrecedingTotal
SucceedingTotal
«enumeration»
AcquisitionMethodValue
Measurement
Simulation
CalibratedSimulation
Estimation
Unknown