



**GeoSmartCity**



**INSPIRE Conference 2016**

Barcelona, 26th - 30th September



# Workshop

**The GeoSmartCity Hub: a data platform for supporting the operativeness of Smart Cities**

**Using and extending INSPIRE data models**

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# Summary

- Methodology for the production of the GSC data models
- INSPIRE Data Specification extension approach
- An insight into the GSC extended data models
- Validation of extended schemas

# Methodology for the production of the GSC data models

## Collect requirements

- Create a template file in order to collect the users' data modelling requirements in a structured way.
- Request each pilot to provide the list of information (attributes, code list ..) needed to run its use cases.

## Analyse & Compare

- Align different pilots' data modelling requirements (whereas feasible, group requirements into common classes)
- Compare data requirements so collected to the relevant INSPIRE Data Specifications

## Extend data models

- Provide an extension of the INSPIRE data models to take into account requirements not covered by the INSPIRE DS
- Provide detailed instructions for maintenance of the schemas and the revision loop

## Validate results

- Successfully validate the produced schemas against encoding requirements using desktop (Oxygen) and online (OGC CITE test Suite) tools.

# The INSPIRE DS extension approach



**INSPIRE**  
Infrastructure for Spatial Information in Europe

## INSPIRE Generic Conceptual Model

<b>Title</b>	D2.5: Generic Conceptual Model, Version 3.4
<b>Status</b>	Version for Annex II/III data specifications v3.0
<b>Creator</b>	Drafting Team "Data Specifications"
<b>Date</b>	2014-04-08
<b>Subject</b>	Generic Conceptual Model of the INSPIRE data specifications
<b>Publisher</b>	Drafting Team "Data Specifications"
<b>Type</b>	Text
<b>Description</b>	Generic Conceptual Model of the INSPIRE data specifications
<b>Contributor</b>	Members of the INSPIRE Drafting Team "Data Specifications", INSPIRE Spatial Data Interest Communities & Legally Mandated Organisations, INSPIRE Consolidation Teams and other Drafting Teams
<b>Format</b>	Portable document format (pdf)
<b>Source</b>	Drafting Team "Data Specifications"
<b>Rights</b>	Public
<b>Identifier</b>	D2.5_v3.4
<b>Language</b>	En
<b>Relation</b>	n/a
<b>Coverage</b>	Project duration

## Annex F (informative)

### Example for an extension to an INSPIRE application schema

#### F.1 Introduction

The agreement on harmonised data specifications addresses the need of users, in particular pan-European users, to combine multiple spatial data sets without repetitive manual intervention and in such a way that the result is coherent. This requires an effort to transform the existing spatial data to the new harmonised data specifications. In the long-term, it is the hope that less and less effort will be required for such transformations and that data providers start to re-use the harmonised data specifications as the basis for their spatial data sets in case they are restructured. Since national spatial data sets will in almost all cases contain information not covered by the INSPIRE data specifications, national SDIs or community SDIs will typically have to extend the INSPIRE data specification for their own purpose.

The Generic Conceptual Model has been designed to support such extensions. This annex provides an example for a simple extension.

#### F.2 General rules

The INSPIRE data specifications have been developed through a process involving the European stakeholders. While the future maintenance of the specifications has not yet been fixed, it is reasonable to assume that this will be the case in the future, too. The INSPIRE

Extending an INSPIRE data specification would imply at a minimum that:

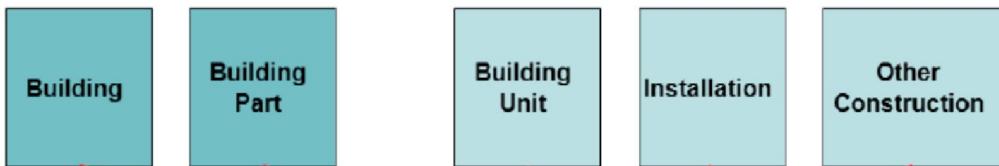
- the extension does not change anything in the INSPIRE data specification but normatively references it with all its requirements
- the extension does not add a requirement that breaks any requirement of the INSPIRE data specification

However, the extension may, for example, do any of the following:

- add new application schemas importing INSPIRE or other schemas as needed
- add new types and new constraints in your own application schemas
- extend INSPIRE code lists as long as the INSPIRE data specification does not identify the code list as a centrally managed, non-extensible code list
- add additional portrayal rules

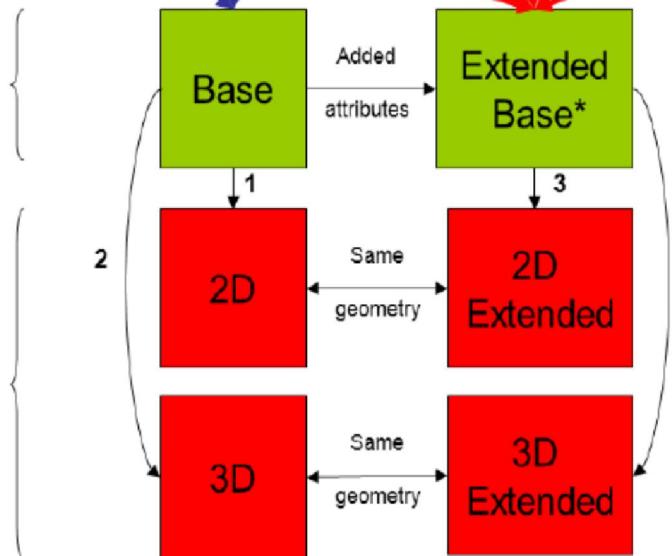
In addition to these general rules that are mainly implied by the rules of UML, further harmonisation will be achieved, if the extensions conform to all requirements of this document and the document "Guidelines for the encoding of spatial data", too.

## Main feature types



Semantics

Geometry



*Alternative deliveries:*

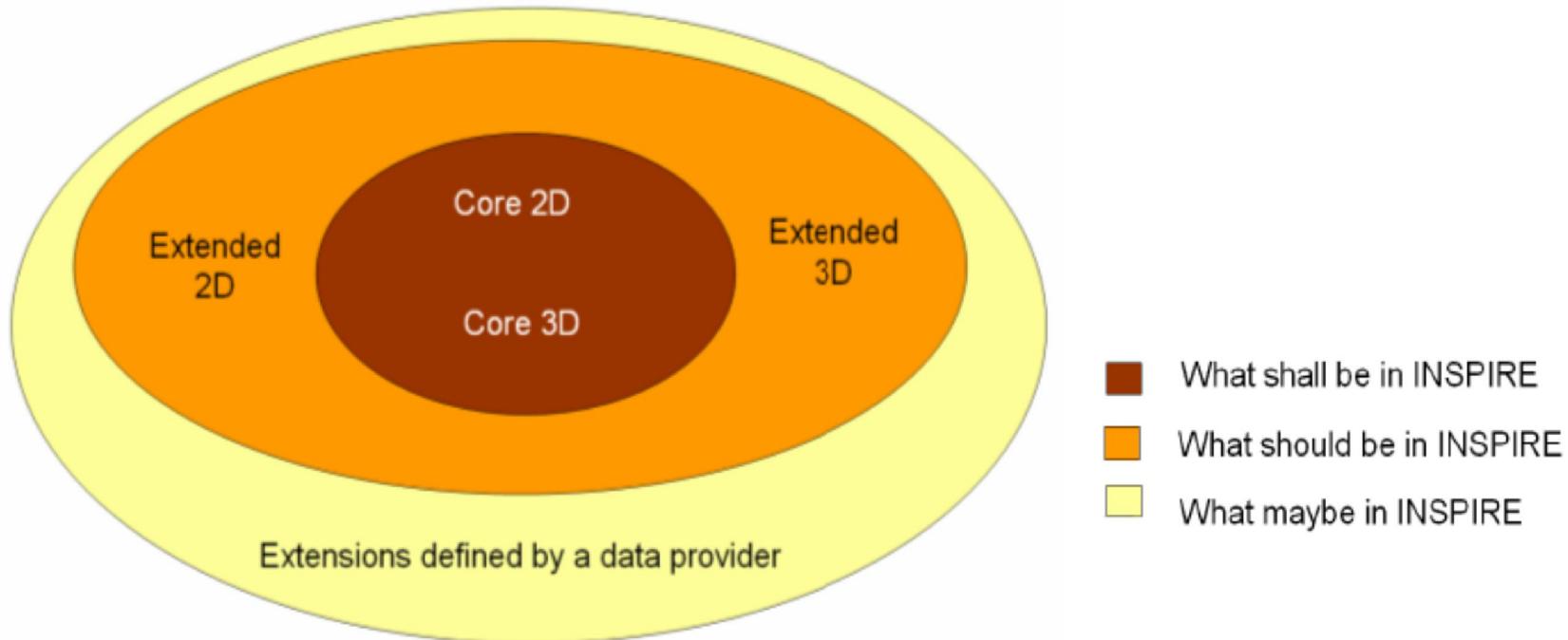
- 1 = simple semantics + 2D geometry
- 2 = simple semantics + 3D geometry
- 3 = extended semantics + 2D geometry
- 4 = extended semantics + 3D geometry + additional 3D feature types

\*Includes Building Base

Figure 3: Content and structure of application schemas for theme Buildings

Feature types are represented in blue. Abstract application schemas are represented in green. Instanciable application schemas are represented in red.

**NOTE:** Data producers may also extend INSPIRE profiles by other information not included in this specification, under the condition they respect the rules provided in the Generic Conceptual Model.



**Figure 4: Modular approach for modelling Buildings theme**



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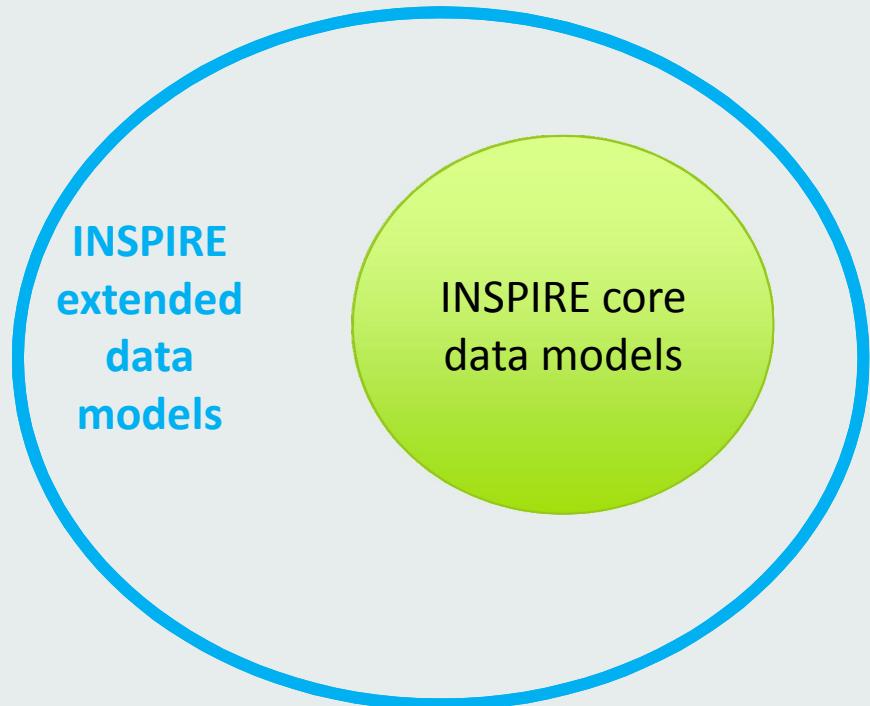
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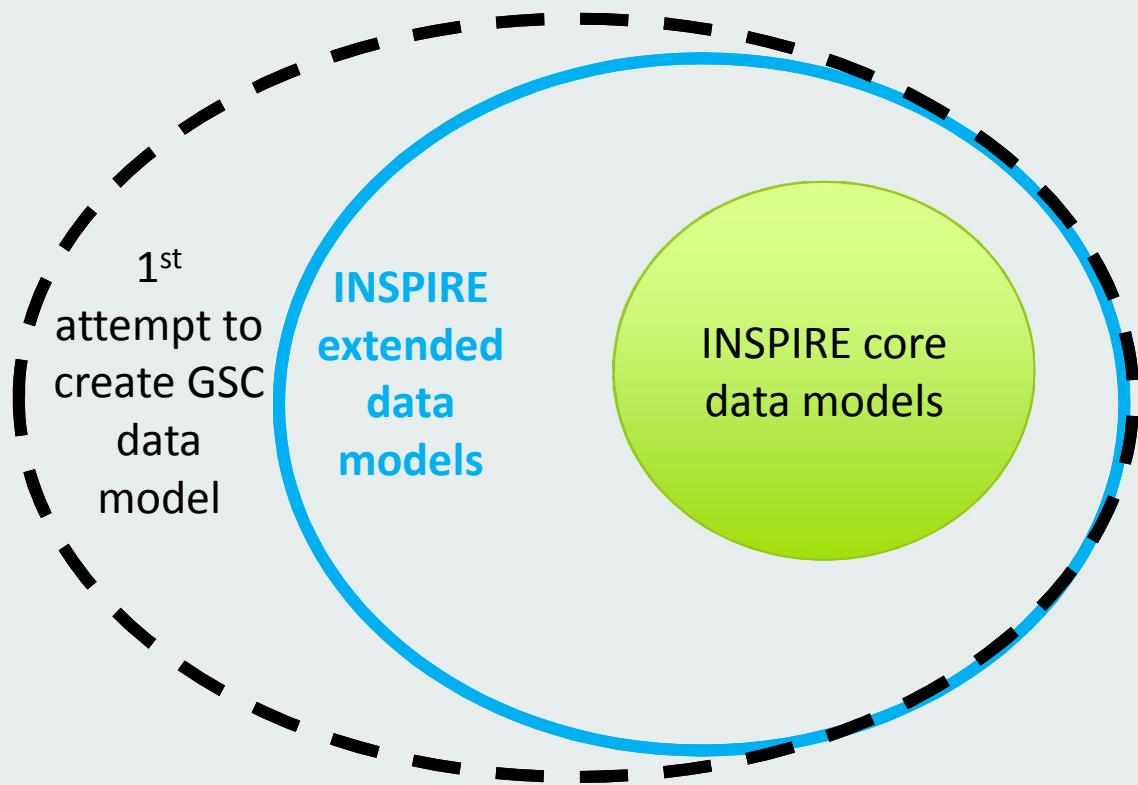
# The GSC Data Model extension approach

INSPIRE core  
data models

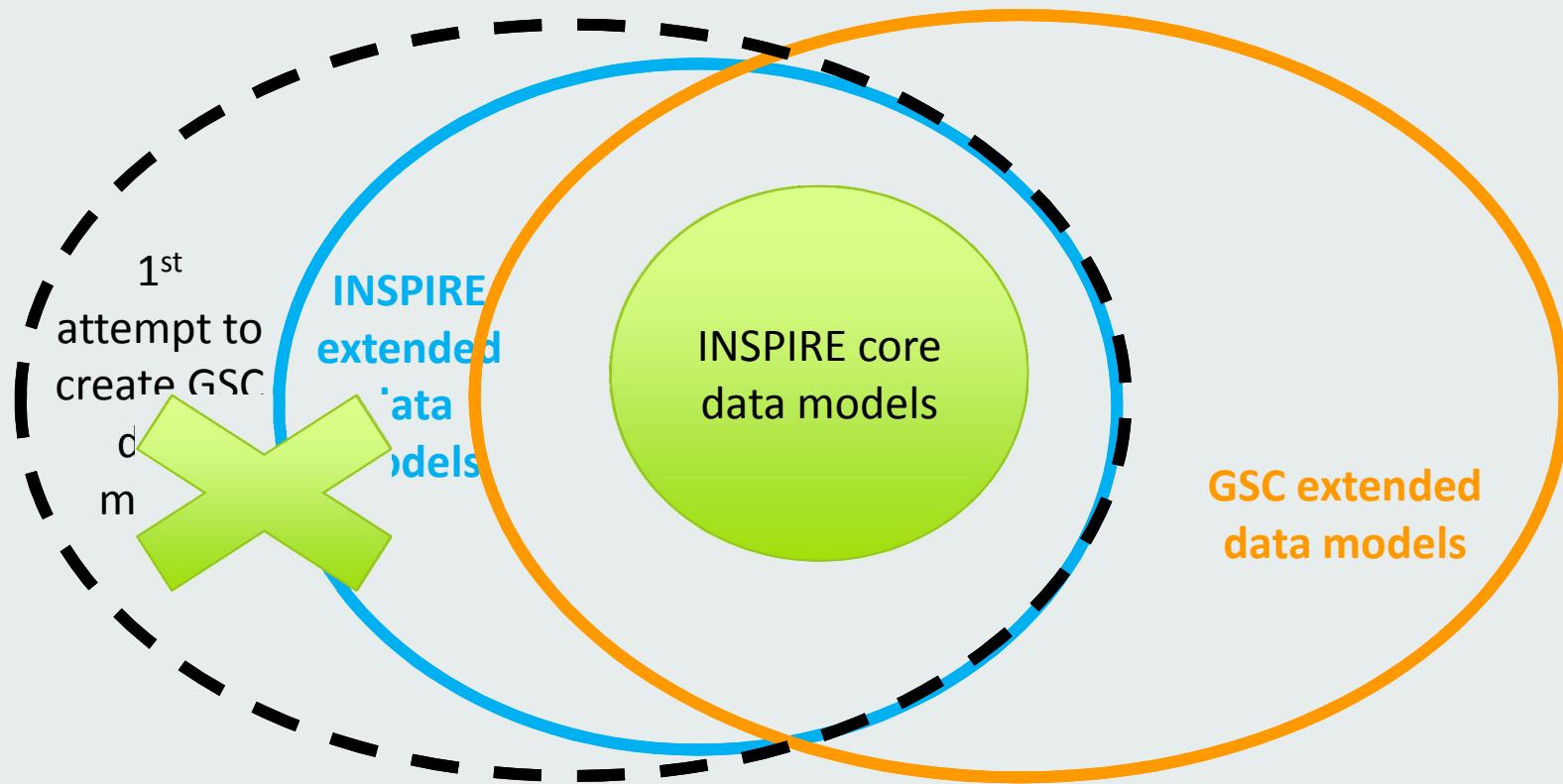
# The GSC Data Model extension approach



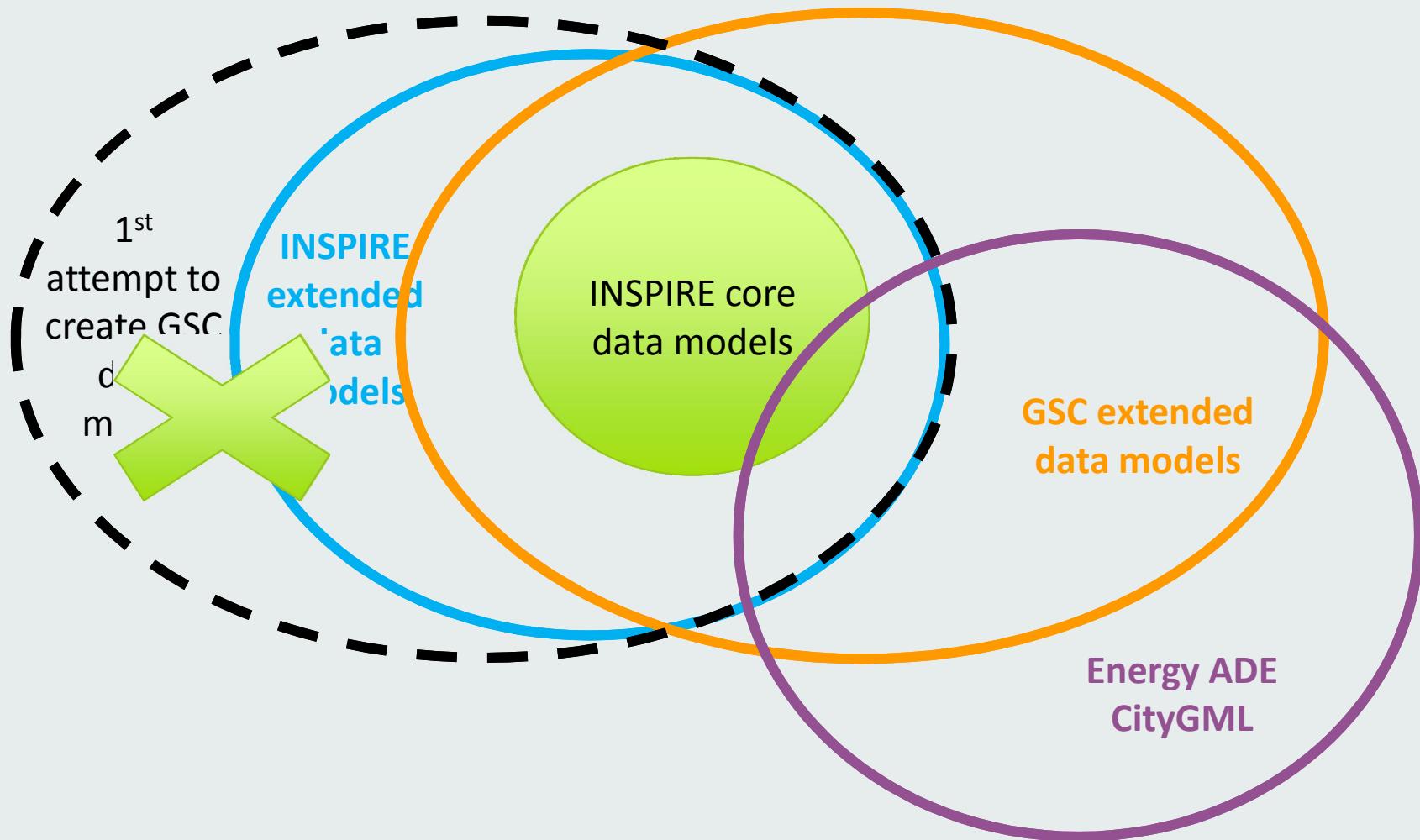
# The GSC Data Model extension approach

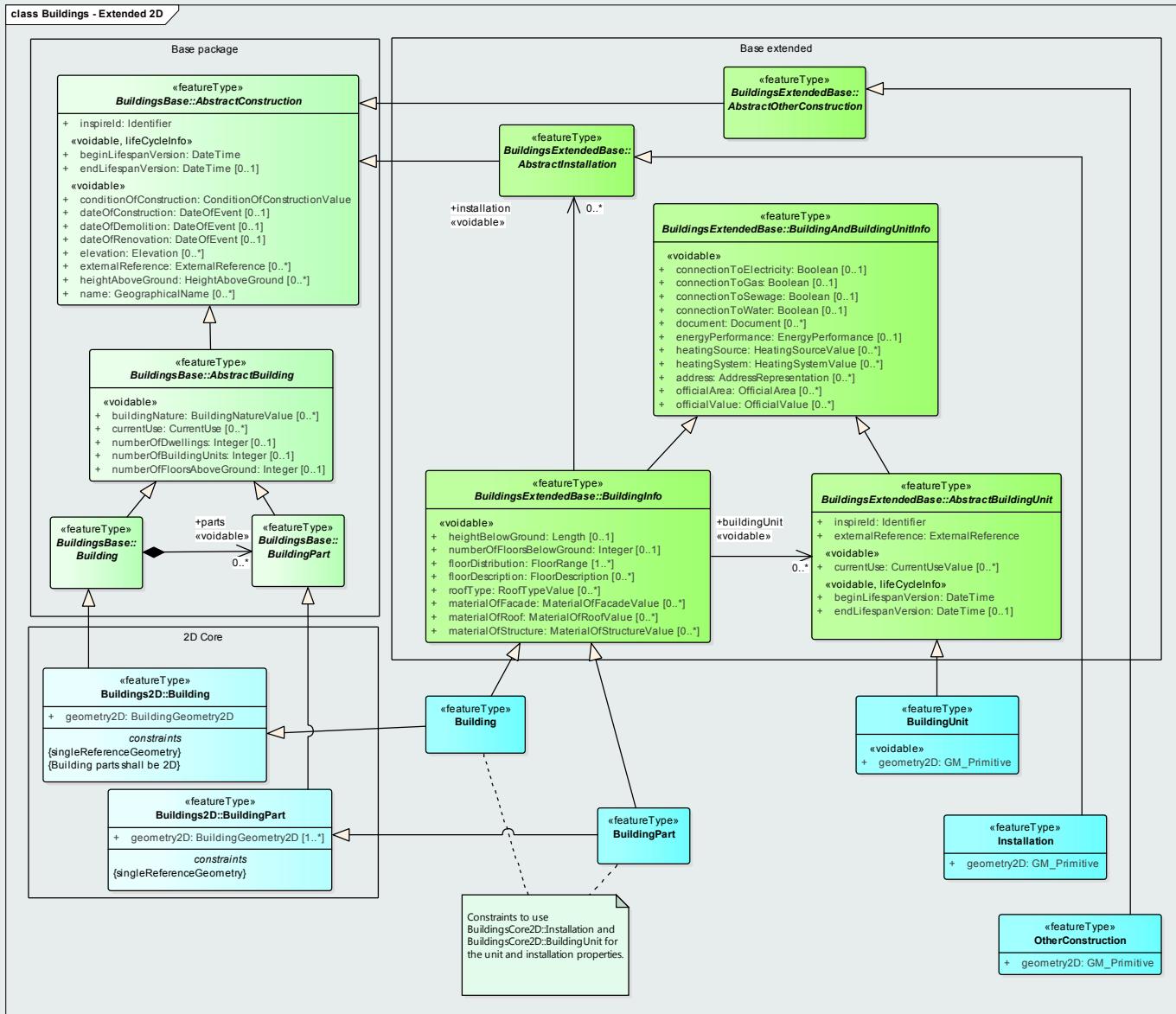


# The GSC Data Model extension approach

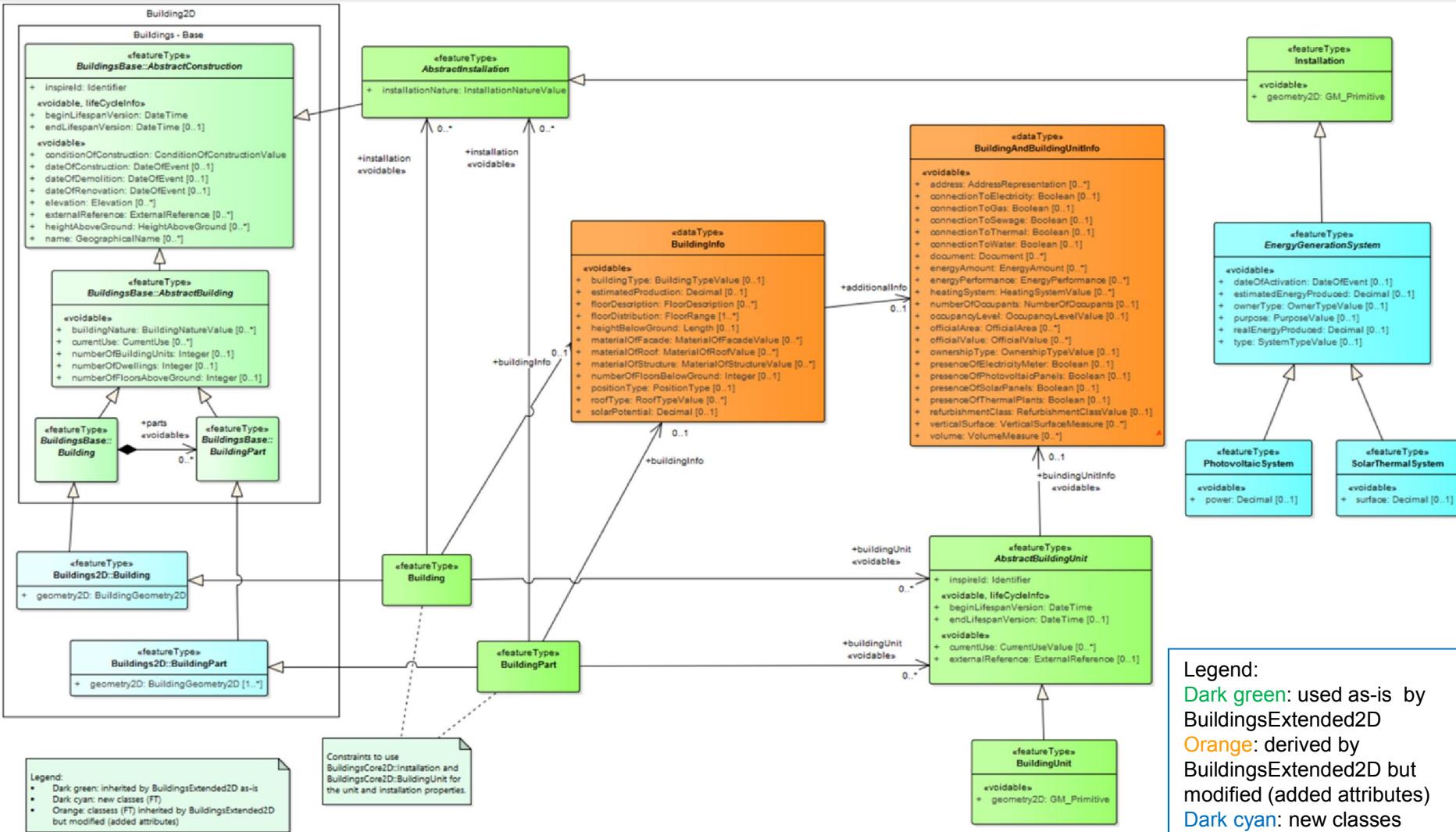


# The GSC Data Model extension approach





# GeoSmartCity – Green Energy Scenario Data Model



Legend:	BuildingsCore2D:Installation and BuildingsCore2D:Building for the unit and installation properties
■ Dark green: inherited by BuildingsExtended2D as-is	
■ Dark cyan: new classes (FT)	
■ Orange: classes (FT) inherited by BuildingsExtended2D but modified (added attributes)	

**Legend:**

- Dark green:** used as-is by BuildingsExtended2D
- Orange:** derived by BuildingsExtended2D but modified (added attributes)
- Dark cyan:** new classes



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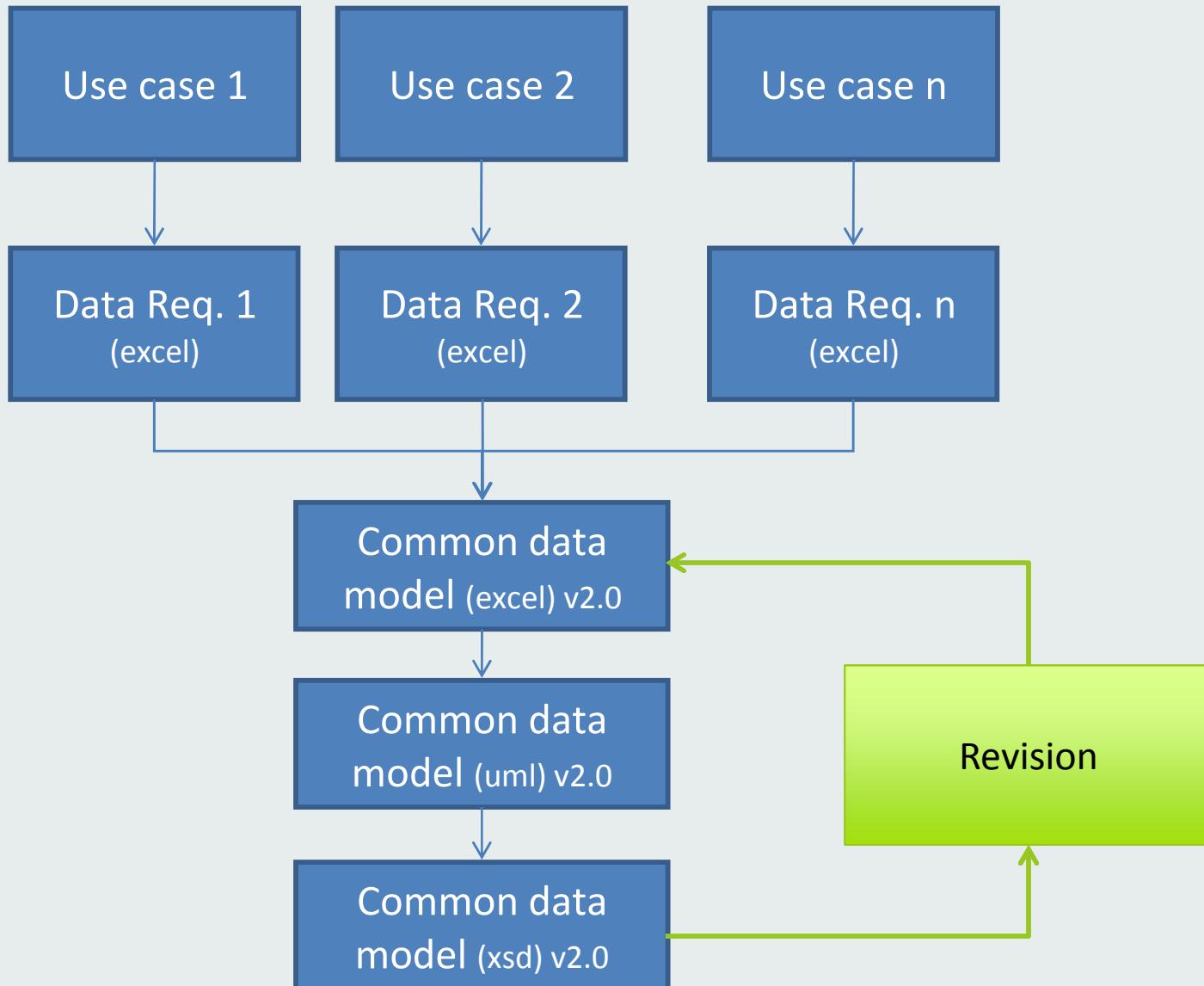


# The GSC Data Model extension approach

**Starting point:** relevant INSPIRE core schemas.

**Steps of the development process:**

- INSPIRE matching tables were used to identify the corresponding concepts (attributes, associations, code lists) between INSPIRE and GeoSmartCity data models.
- Enterprise Architect software tool was used to create the logical model using UML class diagrams and to transform them into relevant application schemas. To extend the INSPIRE schemas the relevant INSPIRE themes were imported into the GSC data model in the EA project.



UC-GSCP07-01	UC-GSCP07-02	UC-GSCP07-03	UC-GSCP07-01	UC-GSCP09-01	UC-GSCP09-02	UC-GSCP08-01	DATA LOGIC NAME	DESCRIPTION LOGIC NAME	DATA TYPE	INSPIRE (<DataTheme>,<AttributeName>)
<b>P07</b>										
1	1	1					Underground.LinearClass.GEOMETRY_3D	Segment of the network described according its type in the whole network	Geometry	Utility and Government Services.Common Utility Network Elements.UtilityLink.centrelineGeometry
2	2	2					Underground.LinearClass.COD_CLASSE	Numeric code of the class according to the Content Specification for the Topographic DB rule	Text(6)	Utility and Government Services.Common Utility Network Elements.UtilityLink.inspireId.localId- Si crea il localId come formattato string Cod_classe-FileID ??
3	3	3					Underground.LinearClass.FILE_ID	Unique progressive identifier of the class objects	Integer(19)	Utility and Government Services.Common Utility Network Elements.UtilityLink.inspireId.localId. Si crea il localId come formattato string Cod_classe-FileID ??
4	4	4					Underground.LinearClass.L_CREATION	Input date of the object into the Municipality Geographic Information System	Date	Utility and Government Services.Common Utility Network Elements.UtilityLink.beginLifespanVersion
5	5	5					Underground.LinearClass.COM_ISTAT	ISTAT code of the Municipality in the format rrpppccc (rr=Region, pp=Province, ccc=Municipality)	Text(8)	
6	6	6					Underground.LinearClass.TP_STR_COD	Code of the road	Text(8)	
7	7	7					Underground.LinearClass.TP_STR_NOM	Name of the road	Text(254)	
8	8	8					Underground.LinearClass.ES_AMM_CF	Functional classification of the road	Code list	
9	9	9					Underground.LinearClass.L_EG_COD	Fiscal code/VAT number of the managing authority	Text(16)	
10	10	10					Underground.LinearClass.L_EG_NOM	Name of the managing authority	Text(50)	Common Utility Network Elements.UtilityNetwork.authority role
11	11	11					Underground.LinearClass.L_BORN	Date of the installation/setup/workability	Date	Utility and Government Services.Common Utility Network Elements.UtilityLink.validFrom
12	12	12					Underground.LinearClass.L_DIA	Nominal diameter in mm	Integer(8)	Utility and Government Services.Common Utility Network Elements.Pipe.pipeDiameter
13	13	13					Underground.LinearClass.L_LUNG	Length in m	Decimal	Utility and Government Services.Common Utility Network Elements.duct.length?
14	14	14					Underground.LinearClass.L_MAT	Type of material	Code list	Utility and Government Services.Common Extended Common Utility Network Elements.Pipe.PipeMaterialType

Type New Type	Docume ntation	Attribute Association role New attribute	Attribute / Association role Documentation	Values / Enumeration	Multipli city	Voidab le / Non- Voidable	Pilot 01	Pilot 02	Pilot 03	NOTE by EP01+SGIS	Review by EPSIT
<b>Building</b> Super types: <i>Building BuildingAbstractBuildi ngAbstractConstr uctionBuildingInfo BuildingAndBuilding UnitInfo</i>	-- Name -- Building A Building is an enclosed <b></b>construction <b></b>above and/or underground, used or intended for the shelter of humans, animals or things or for the production of economic goods. A building refers to any structure permanently constructed or erected on its site.										
	<b>beginLifespanVersion</b>	-- Name -- Begin lifespan version Date and time at	Date Time	1	voidable						
	<b>conditionOfConstruction</b>	-- Name -- Condition of construction Status of the	ConditionOfCons tructionValue	1	voidable						
	<b>dateOfConstruction</b>	-- Name -- Date of construction Date of	DateOfEvent	0..1	voidable						
	<b>dateOfDemolition</b>	-- Name -- Date of demolition Date of demolition	DateOfEvent	0..1	voidable						
	<b>dateOfRenovation</b>	-- Name -- Date of last major renovation Date of last	DateOfEvent	0..1	voidable						
	<b>RefurbishmentClass</b>										OK, it is a property of a "Building"/"BuildingPart" or
	<b>elevation</b>	-- Name -- Elevation Vertically constrained	Elevation	0..*	voidable		Building.Elevation value				
	<b>endLifespanVersion</b>	-- Name -- End lifespan version Date and time at	Date Time	0..1	voidable						
	<b>externalReference</b>	-- Name -- External reference Reference to an external	ExternalReferen ce	0..*	voidable						
	<b>heightAboveGround</b>	-- Name -- Height above ground Height above	HeightAboveGro und	0..*	voidable		Building.height; Building.height_st			Multiplicity [1]	This attribute is defined in the INSPIRE "Building2D"
	<b>inspireId</b>	-- Name -- inspire id External object identifier of the	Identifier	1							
	<b>name</b>	-- Name -- Name of the construction EXAMPLES: name	GeographicalNa me	0..*	voidable						
	<b>buildingNature</b>	-- Name -- Building nature Characteristic of the building that	BuildingNatureVa ue	0..*	voidable						
	<b>currentUse</b>	-- Name -- Current use Activity hosted within the building	CurrentUse	0..*	voidable						
	<b>numberOfDwellings</b>	-- Name -- Number of dwellings Number of	Integer	0..1	voidable						
	<b>numberOfBuildingUnits</b>	-- Name -- Number of building units Number of building	Integer	0..1	voidable						
	<b>numberOfFloorsAboveGr</b>	-- Name -- Number of floors above ground Number of	Integer	0..1	voidable						
	<b>parts</b>	The building parts composing the	BuildingPart	0..*	voidable						
	<b>geometry2D</b>	-- Name -- Geometry 2D 2D or 2.5D geometric	BuildingGeometr y2D	1							
	<b>connectionToElectricity</b>	-- Name -- Connection to electricity An indication if	Boolean* TRUE FALSE	0..1	voidable						
	<b>connectionToGas</b>	-- Name -- Connection to gas An indication if the building or	Boolean* TRUE FALSE	0..1	voidable						
	<b>connectionToSewage</b>	-- Name -- Connection to sewage An indication if the	Boolean* TRUE FALSE	0..1	voidable						
	<b>connectionToWater</b>	-- Name -- Connection to water An indication if the	Boolean* TRUE FALSE	0..1	voidable						
	<b>connectionToThermal</b>			Boolean* TRUE FALSE	0..1	voidable			NEW	OK - Could you please provide the	
	<b>document</b>	-- Name -- Document Any document providing information	Document	0..*	voidable						
	<b>energyPerformance</b>	-- Name -- Energy performance The energy	EnergyPerforma nce	0..1	voidable					Multiplicity 0..*	OK



# The GSC Data Model extension approach

To comply with GSC requirements for which no matching attributes were found in the INSPIRE schemas:

- additional attributes were added in GSC feature types derived from the INSPIRE feature types via a generalization relationship in the application schemas (when feasible).
- new feature types – i.e. not derived from INSPIRE ones – were added to deal with concepts not present in INSPIRE
- new code lists / code list values were created only if no corresponding INSPIRE value exists. A registry has been created for GSC codelists at <http://hub.geosmartcity.eu/registry/>

## GeoSmartCity - Underground Scenario Data Model

The GeoSmartCity Utilities and Governmental Services data model inherits the core **INSPIRE** data model for **Utilities and Governmental Services** and extends it by means of:

- **1 “New Common Types” application schema**, which contains definitions for feature types and data types which are not present in the INSPIRE core and that are common to all GSC- extended US schemas
- **6 *network-specific extended* application schemas**, which extend INSPIRE core US feature types adding new attributes and relevant code clist / codelist values:
  - Electricity network
  - Oil, Gas & Chemicals network
  - Sewer network
  - Telecommunications network
  - Thermal network
  - Water network
- **1 *theme-specific extension*** of the Base Model “Activity Complex” application schema according to what stated by D2.10 "The types defined in the Base Model *Activity Complex* are supposed to be extended in the related thematic data specifications"



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# Extension of INSPIRE Utilities and Governmental Services (US) - “Utility networks” sub-model

Focus on the Italian use cases:

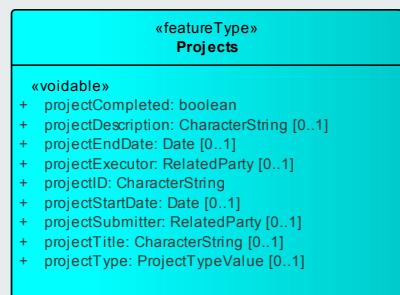
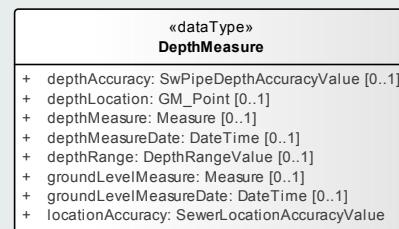
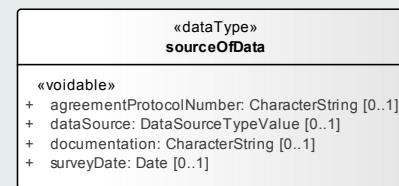
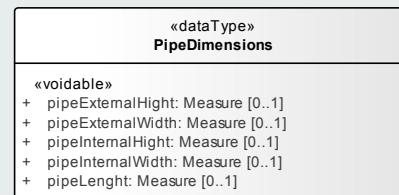
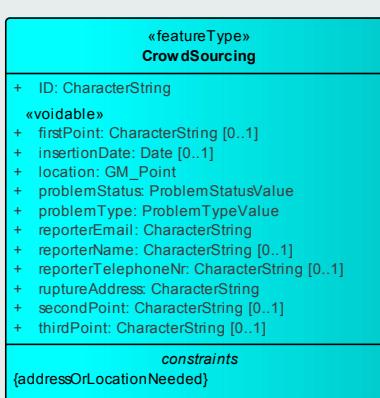
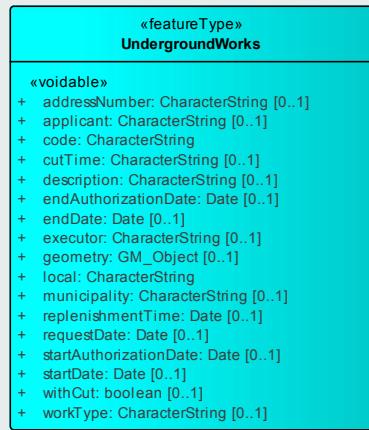
- GSC data modelling process contributed in the studies which led to the alignment of the National Specification on Utility networks to INSPIRE Directive requirements.
- GSC extends INSPIRE so that information included in National Specifications which does not correspond to any element in the INSPIRE models is taken into account.

Focus on the Flanders Region use cases:

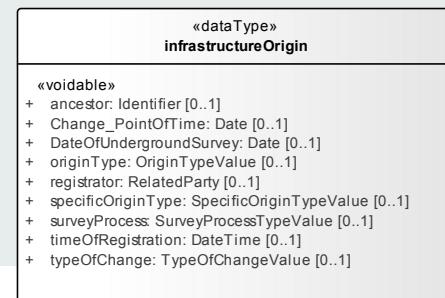
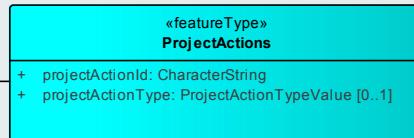
- GSC data model extends INSPIRE US data model taking into account the information needed by Flanders sewer network management (Aquafin's AQS2.0 data model which in turn is derived from IMKL)

# “New Common Types” application schema

```
class GSC-NewCommonTypes
```



+belongsTo  
1



Legend:

Dark cyan: new classes

White: new data types



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## GeoSmartCity – code lists management

INSPIRE code list register

ID: <http://hub.geosmartcity.eu/registry/codelist>

Label: INSPIRE code list register

Content Summary: The INSPIRE code list register contains the code lists and their values, as defined in the INSPIRE implementing rules on interoperability of spatial data sets and services (Commission Regulation (EU) No 1089/2010). NOTE: It does not yet include references to external code lists and the additional code lists and extended values proposed in the Data Specification Technical Guidelines.

Owner: European Union

Register manager: European Commission, Joint Research Centre

Control body: INSPIRE Maintenance and Implementation Group (MIG)

Submitter: Members of INSPIRE Maintenance and Implementation Group (MIG)

Contact point: JRC INSPIRE Registry Team

Licence: Europa Legal Notice

Other formats: XML (beta), XML (ISO 19139), RDF/XML beta, JSON, Atom, CSV beta

Code list

Label	Theme	Application schema	Status
Building Type	Buildings	GSC - Building2D-Energy	Valid
Cable size ranges	Utility and Governmental Services	GSC Electricity Network	Valid
GbE cable size ranges	Utility and Governmental Services	GSC Ethernet Network	Valid

The Re3gistry open source software has been reused in order to manage new code lists and/or code list values.



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## Results for "GeoSmartCity"

### Discussion topics

[Webinar on data transformation with HALE using the GeoSmartCity extended Buildings data model](#)

The registration of the webinar on data transformation with HALE using the [GeoSmartCity](#) extended Buildings data model is available here. The link to download the material used in the webinar is provided in the video description field.

478 days ago

[Extended US Data Model to manage underground networks](#)

An extended INSPIRE data model for Utility Networks has been created in the frame of the [GeoSmartCity](#) EU funded project. It extends the INSPIRE core Utility Networks schemas, re-using...

313 days ago

[Extended BU Data Model for energy efficiency](#)

An extended INSPIRE data model for Buildings has been created in the frame of the [GeoSmartCity](#) EU funded project. It extends the INSPIRE BuildingsCore2D schema, re-using some elements...

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