Geo and BIM integration in-progress methods and standards

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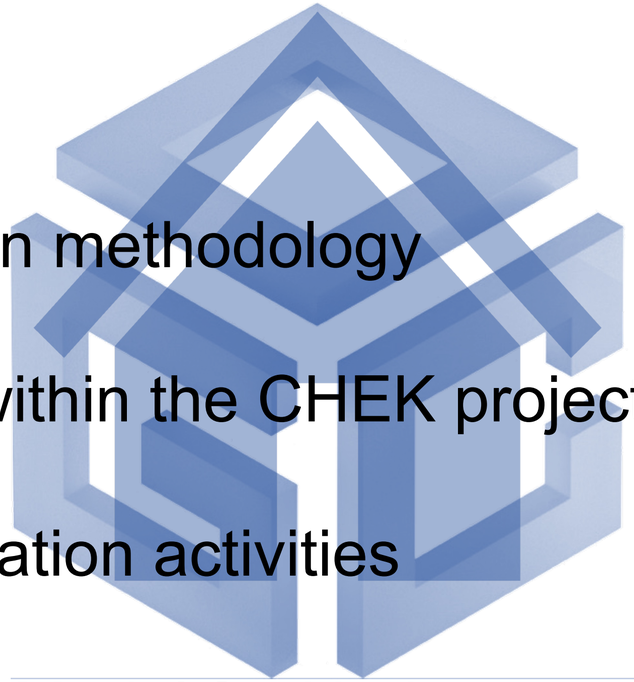
Overview



A GeoBIM integration methodology

The developments within the CHEK project

On going standardisation activities

A focus on the OGC Model for Underground Data Definition and Integration (MUDDI)

GeoBIM last years' investigations

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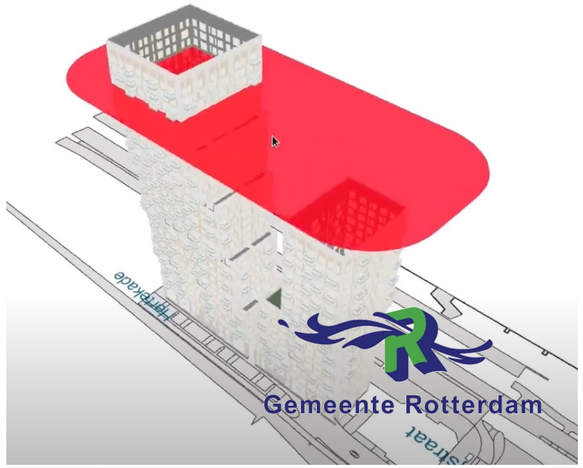
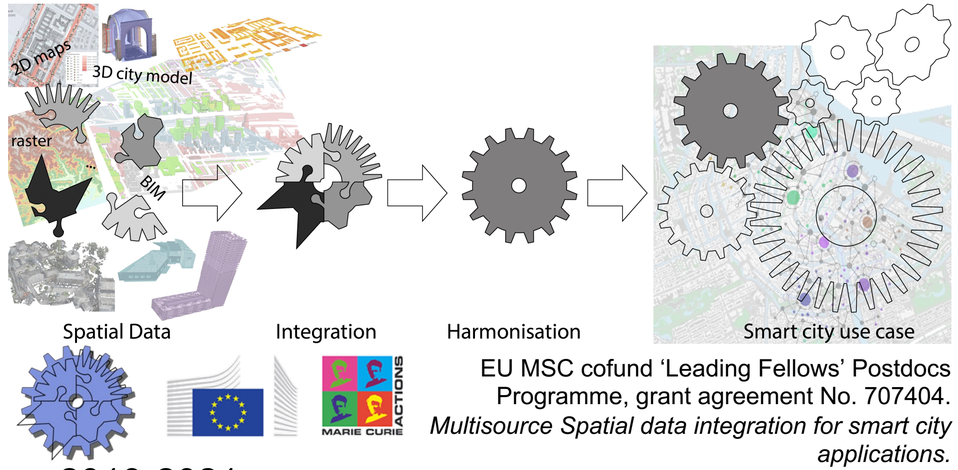
TU Delft 3Dgeoinfo 2017-2020

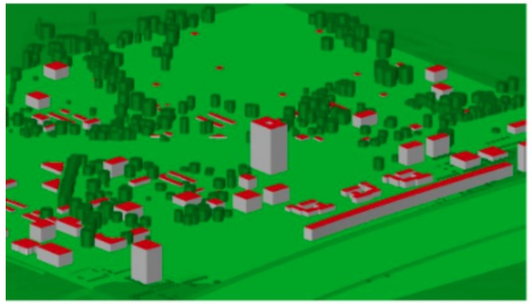


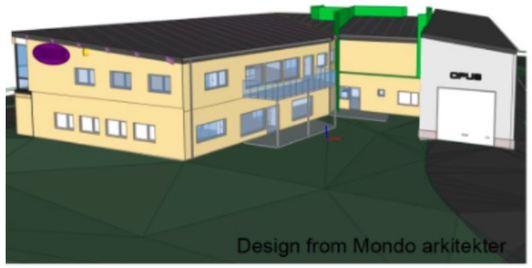
TU Delft 3Dgeoinfo 2019-2021

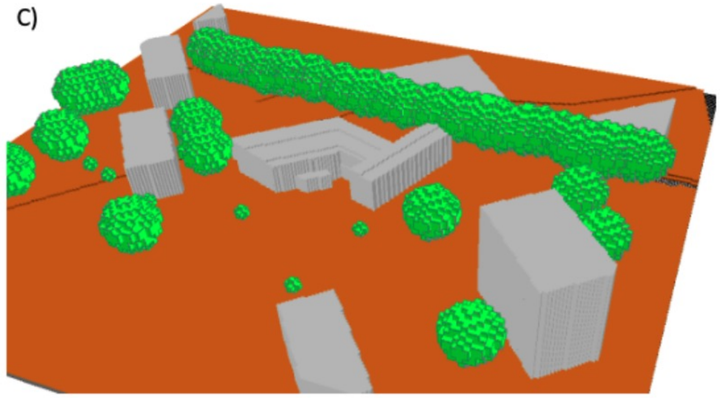


2019-2021

EU MSC cofund 'Leading Fellows' Postdocs Programme, grant agreement No. 707404.
Multisource Spatial data integration for smart city applications.

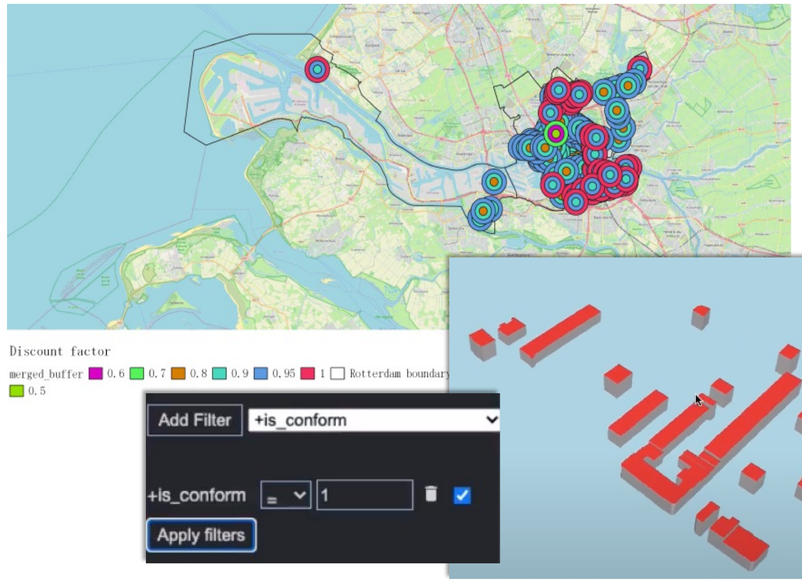






Van Heerden, N., 2021. BIM and 3D City Models as Input for Microclimate Simulation. MSc thesis, Delft University of Technology. http://resolver.tudelft.nl/uuid:630d57be-5660-4971-84c2-83bf12b1d204

TU Delft 3Dgeoinfo



Jialun Wu, 2021. *Automatic building permits checks by means of 3D city models.* MSc thesis, Delft University of Technology, Geomatics
Tool demo: https://drive.google.com/file/d/1gtO4v-iupA5f5SxmhkQhFx2ATMxlWYOZ/view

Integration and Interoperability

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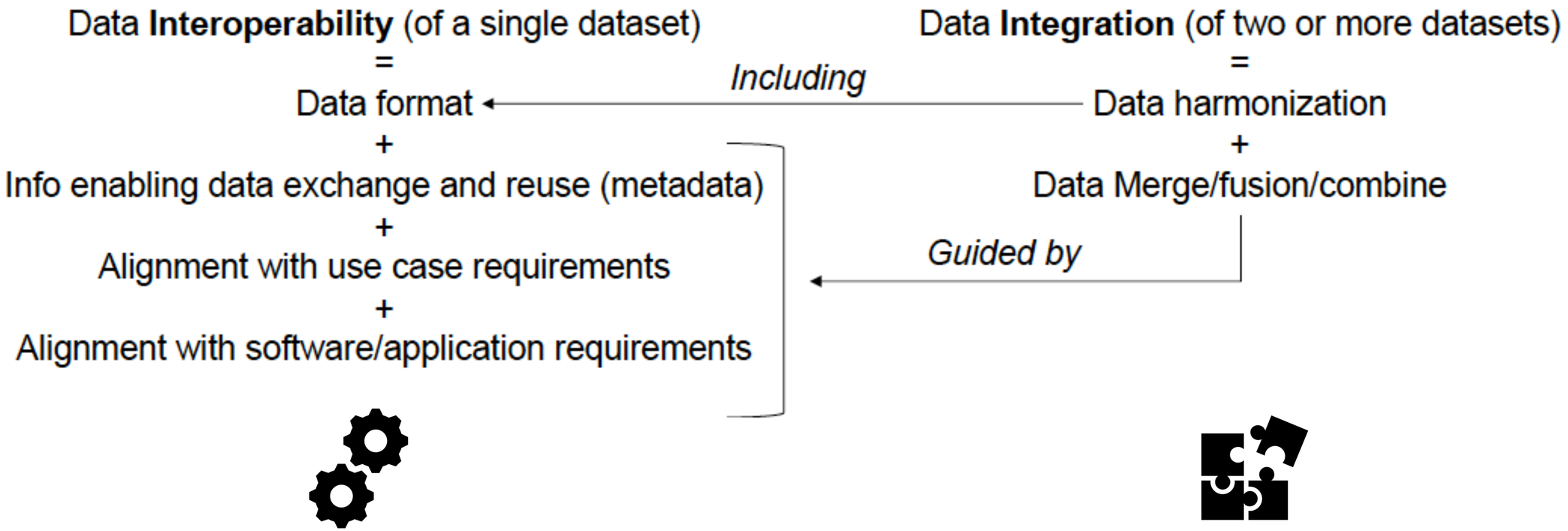

Interoperability is the ability of systems or products to operate effectively and efficiently in conjunction, on the exchange and reuse of available resources, services, procedures, and information, in order to fulfil the requirements of a specific task (Kavouras and Kokla, 2007).

Integration is the combination or conflation of information from different data sets (Worboys, Duckham, 2004).

Supporting Interoperability and integration

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		ISO19115	INSPIRE[21]	IFC	CityJSON
Contents and procedures	*Spatial extent*	Geographic location of the dataset	geographic bounding box		geographicalExtent
	Temporal frame	Dataset reference date, Additional extent information for the dataset	temporal reference, temporal extent, date of last revision, date of creation		datasetReferenceDate
	Scope	Dataset topic category	resource type, topic category	IDM, IDS	datasetTopicCategory
	Goal and use case requirements	Abstract describing the dataset	Resource abstract	IDM, IDS	Abstract, specificUsage
	Lineage	Lineage	Lineage		lineage
	Author	Dataset responsible party	Responsible organization		
	Implementation requirements		specifications[22]		spatialRepresentationType
Geometry	*Accuracy*		specifications		
	Abstraction level	Spatial resolution of the dataset	Spatial resolution		presentLoDs
	Geometry paradigm	Spatial representation type	specifications	IDM, IDS, MVD	
	Topology		specifications	IDM, IDS, MVD	
	Georeferencing	Reference system	specifications	IfcMapConversion	referenceSystem
	Unit of measure		specifications	IfcProject - ProjectUnits	
Semantics	*Entities*		specifications	IDM, IDS, MVD	
	Properties and attributes		specifications	IDM, IDS, MVD	
	Codelists and values		specifications	IDM, IDS, MVD	
	Terms		specifications	IDM, IDS, MVD	
	Accuracy (vagueness)		specifications		
	Approximation level		specifications		
	Semantic paradigm		specifications	IDM, IDS, MVD	
	Language	Dataset language	resource language		datasetLanguage
	Encoding		specifications		
Structure	*Is-a hierarchies;*		specifications	IDM, IDS, MVD	
	Part-of meronymic hierarchies;		specifications	IDM, IDS, MVD	
	Relationships		specifications	IDM, IDS, MVD	
	Reference data model,		specifications	IDM, IDS, MVD	
	version		specifications	IDM, IDS, MVD	
	profile		specifications	IDM, IDS, MVD	
	extensions		specifications	IDM, IDS, MVD	
	Granularity		specifications	IDM, IDS, MVD	
S	*Data format*		specifications	IDM, IDS, MVD	
	Objects' behavior		specifications	IDM, IDS, MVD	

Initial simple rules…

Good **metadata**

Specify data **requirements**

Use Open standards as much as possible

Align with:

- User **requirements**
- Use case **requirement**
- Implementation **requirements**

Noardo, F. Multisource Spatial Data Integration for Use Cases Applications. *Preprints* **2021**, 2021120286 (doi: 10.20944/preprints202112.0286.v1).

The integrability parameters

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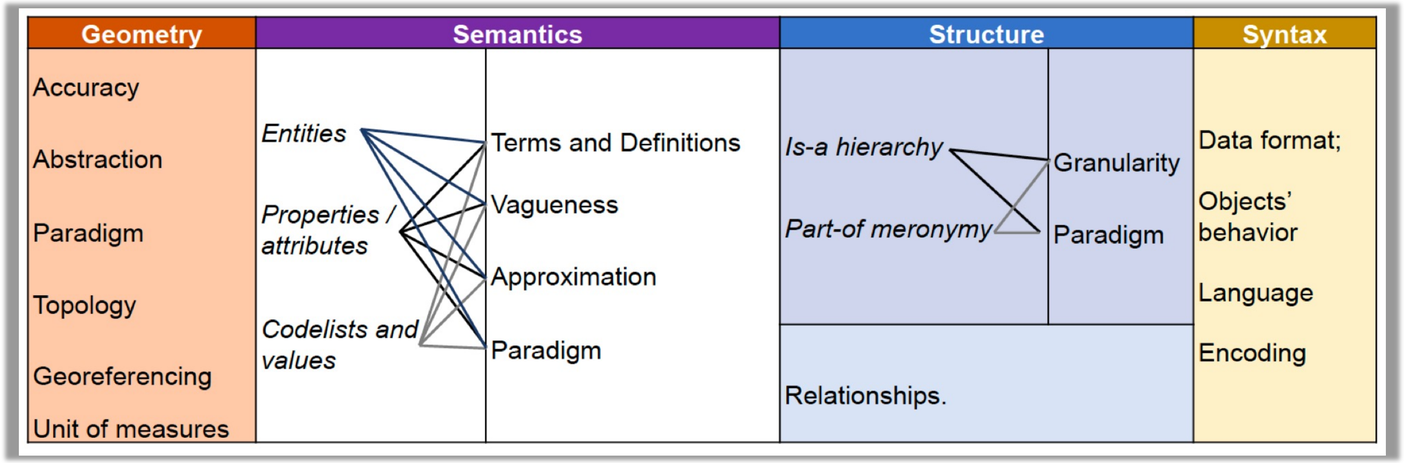
Objective parameters

Integrability Pre-assessment parameters

- Scope
- Spatial / Geographical extent
- Time framework

Integrability Detailed assessment parameters

- Geometry
- Semantics
- Structure
- Syntax



Qualitative parameters

Additional information supporting data interpretation and re-use

- Original goal (intended use)
- (Software-specific) implementation details
- Authorship and context within which data were generated: discipline, ethno-/cultural-/socio-based view, human cognitive diversity
- Lineage

Noardo, F. Multisource Spatial Data Integration for Use Cases Applications. *Transactions in GIS* 2022, 26,7, 2874-2913 (doi: https://doi.org/10.1111/tgis.12987).
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The integration workflow

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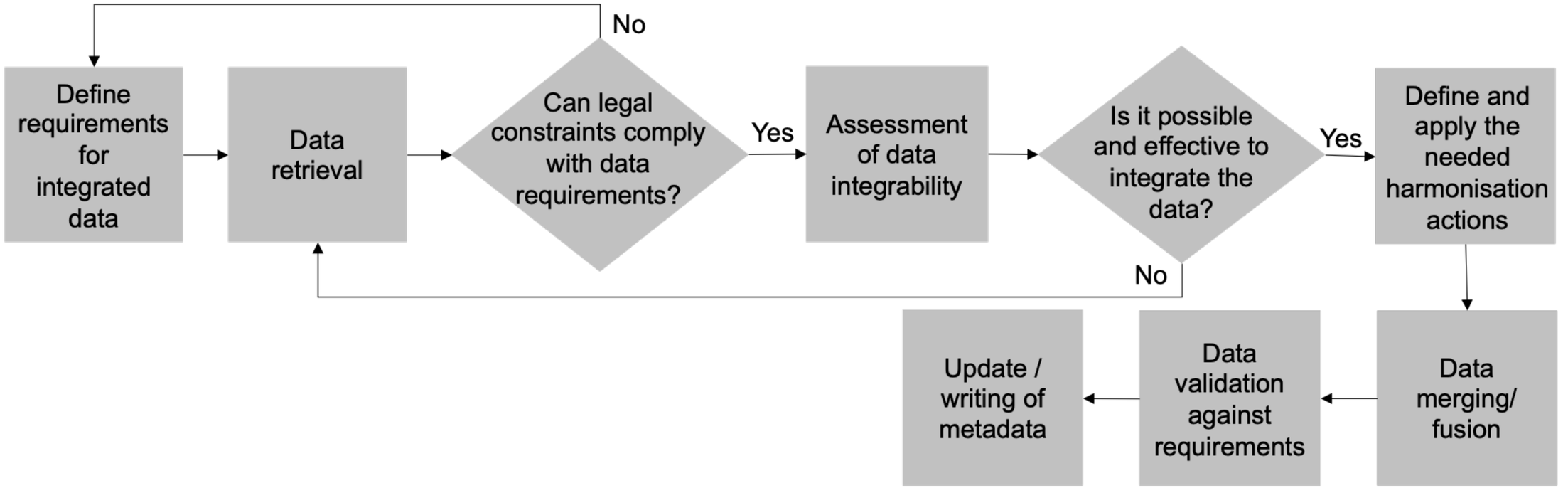

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2-5 May 2023, Rotterdam, The Netherlands

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Horizon Europe HORIZON-CL4-2021-TWIN-TRANSITION-01-10. G.A. 101058559

Approximate budget: 5.000.000 € - 3 years (October 2022-September 2025)

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19 European partners, including international standardisation organisations (OGC, buildingSMART) and is strongly related to the European network for Digital Building Permits (EUnt4DBP).

Research

TU Delft 3Dgeoinfo

Fraunhofer ITALIA

University of Brescia

Universidade do Minho

Software

cype

virtual city systems
digital views. real perspectives.

Xinaps

RDF

DiRoots
connecting the dots

Design

SIA architects

zwei
Architektur.Design

Construction

Mostostal Warszawa

FASADA

Municipalities

LISBOA
CÂMARA MUNICIPAL

GAIURB.EM
URBANISMO E HABITAÇÃO

IPR PRAGUE

Comune di Ascoli Piceno
MEDAGLIA D'ORO AL VALOR MILITARE PER ATTIVITÀ PARTIGIANA

Standardization

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buildingSMART International

@ChekDbp

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Universidade do Minho
Design and lead training development and delivery

Education, training

UNIVERSITÀ DEGLI STUDI DI BRESCIA
zwei Architektur.Design
SIA.architects
Mostostal WARSZAWA
PREFASADA

Assisting in translating the requirements to specifications
Testing the guidelines to produce models
Connect to construction industry

BIM software

Requirements

Standardisation

Analysis software

OpenAPI-based modular platform for DBP: process management, data assurance, access control, (semi-)automatic checking and processing tools

DBP toolkit

GIS software

Assisting in translating the requirements to specifications

Officialize the use of standard / integrating them / best practices

Develop automatic compliance checkng tools based on BIM.

Develop automatic compliance checking tools based on 3D GIS.

Develop GeoBIM conversio n tools

Develop and implement the platform

Permittig process change

Define requirements from regulations and process needs

Support the process change

Test, demonstrate scalability, adopt

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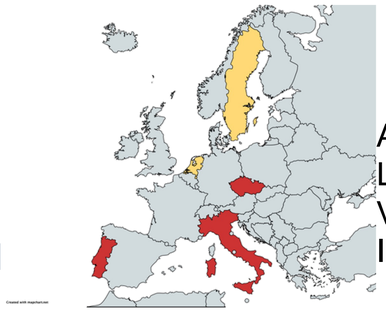
Open Geospatial Consortium
buildingSMART International
cype
Xinaps
virtual city systems
RDF
TU Delft 3Dgeoinfo
cype
DiRoots connecting the dots
Fraunhofer ITALIA



CHEK Municipalities:
Ascoli Piceno
Lisbon
Vila Nova de Gaia
IPR – Prague
+ CHEK community

GAIURB.EM
LISBOA CÂMARA MUNICIPAL
IPR PRAHA

October 2022 — Developments — October 2024 — Demonstration — September 2025

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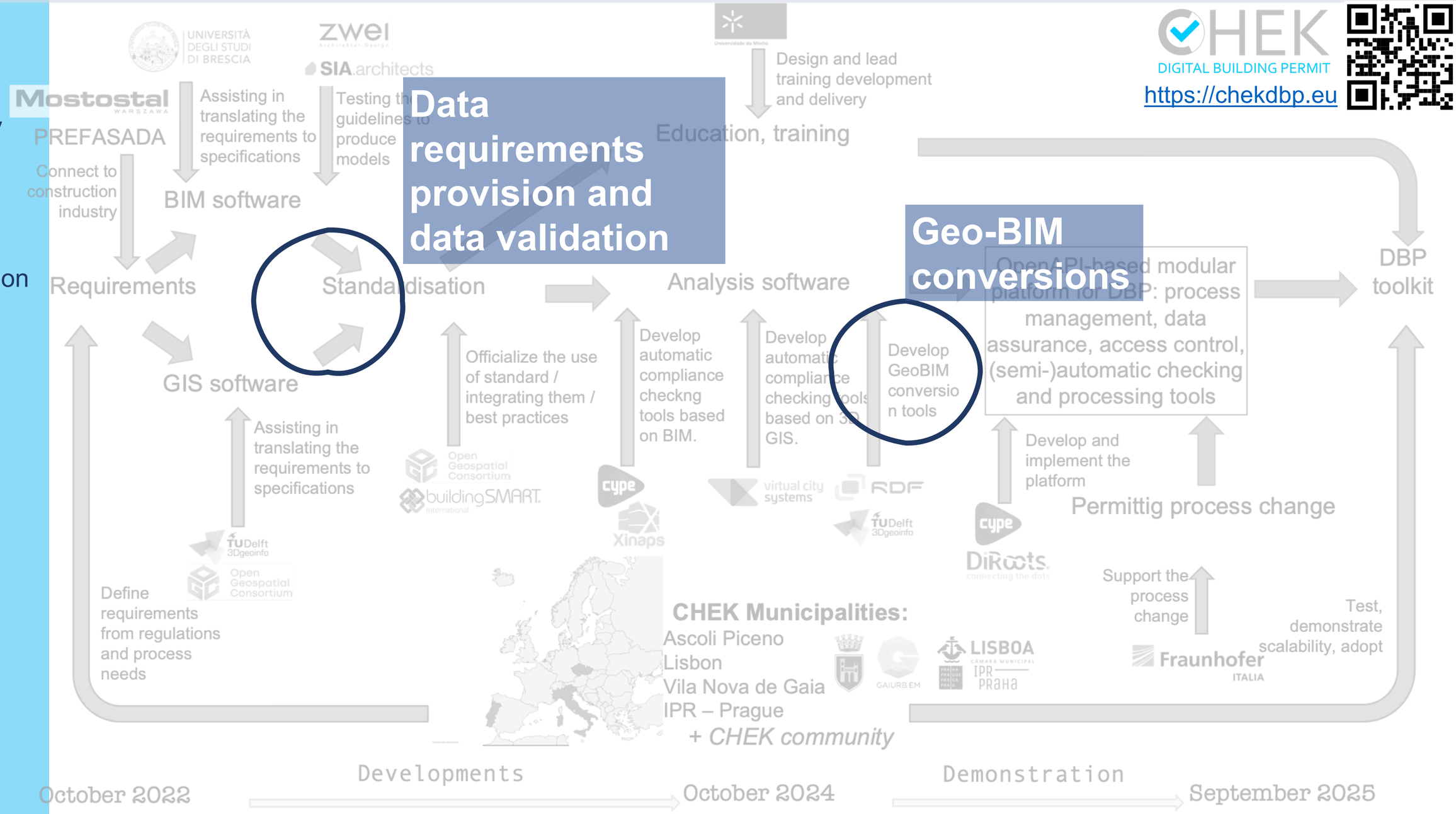

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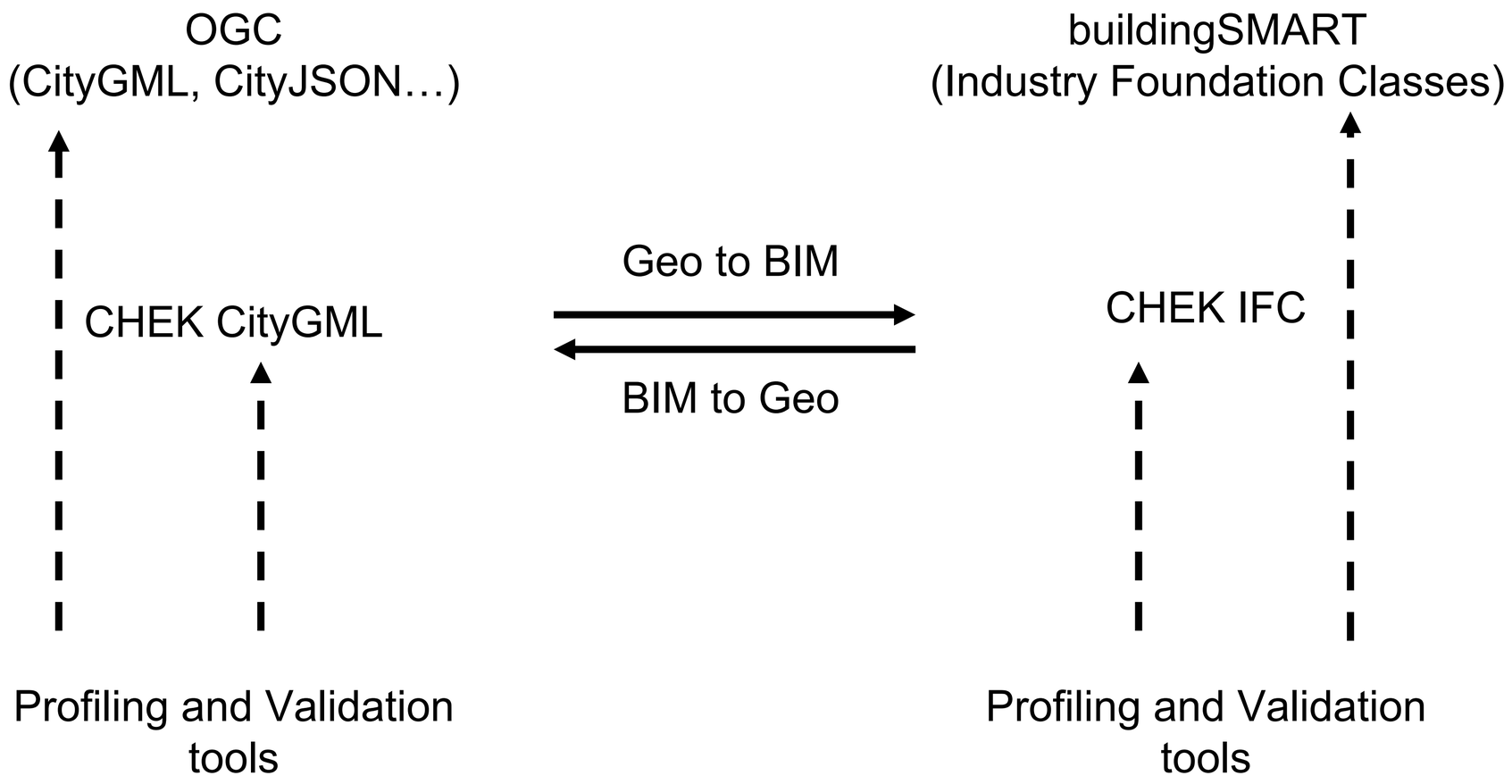

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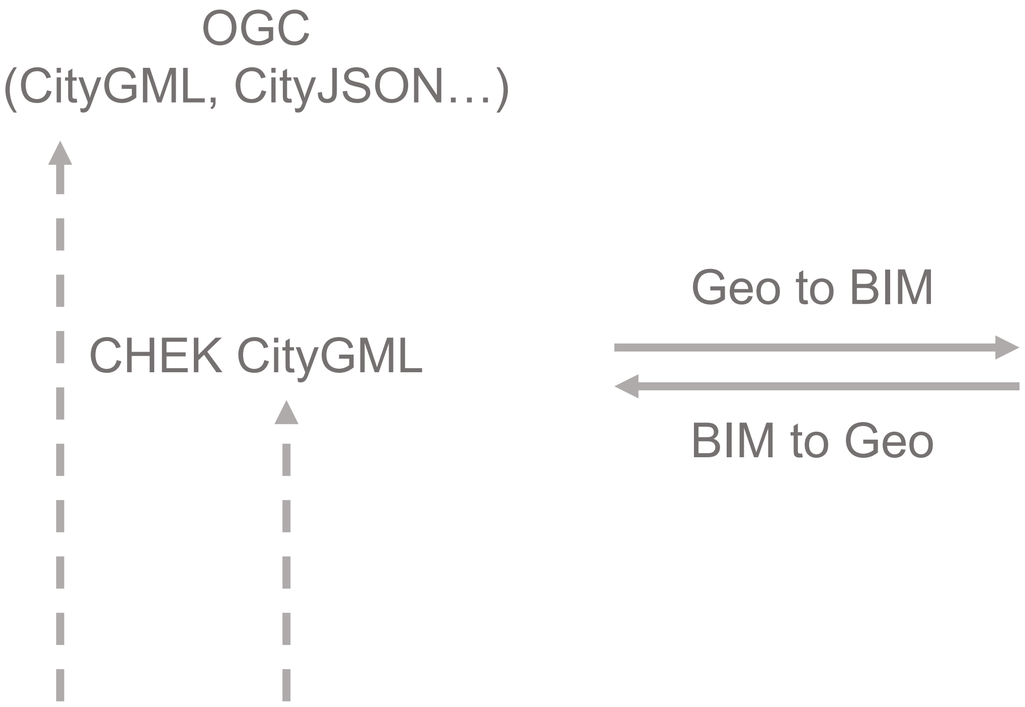

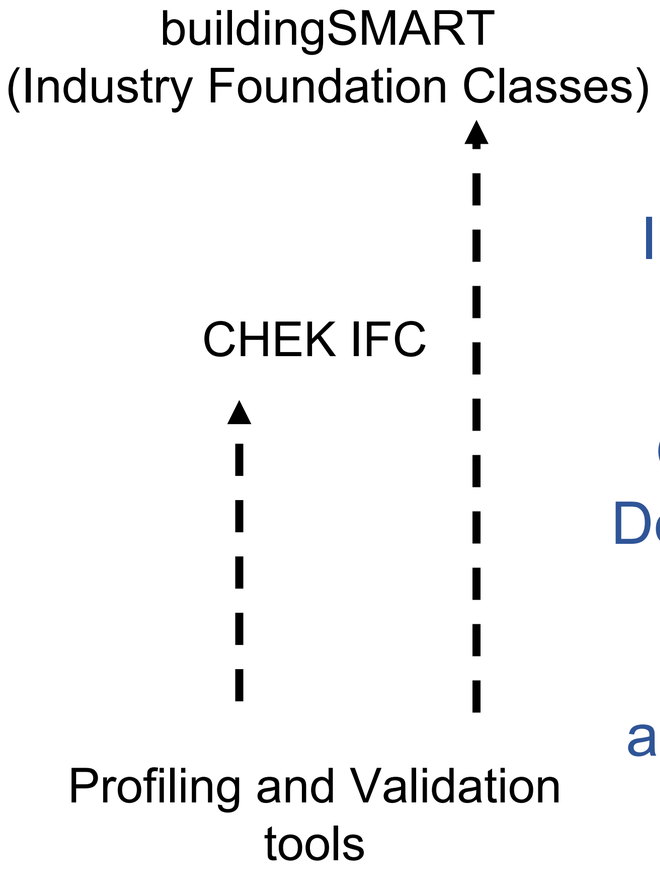

IFC 4.3

IFC georeferencing tool

CHEK Information Delivery Specification (IDS)
/
alternative (MVD …)

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OGC Data Exchange Toolkit

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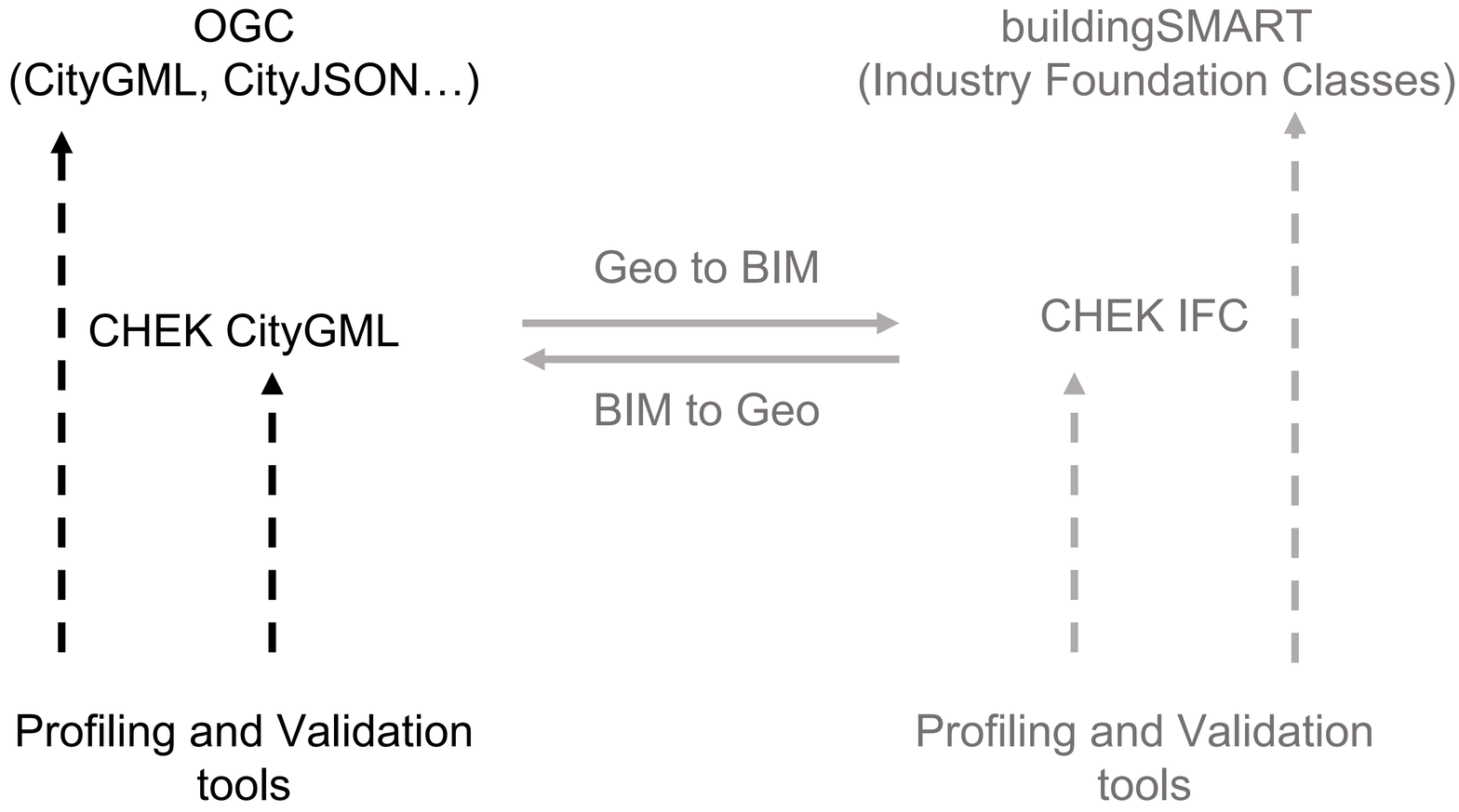
Standard data model profiling tool

↑↓

Data requirements specification template

- Explain data requirements
- Validate data against standard-based data requirements



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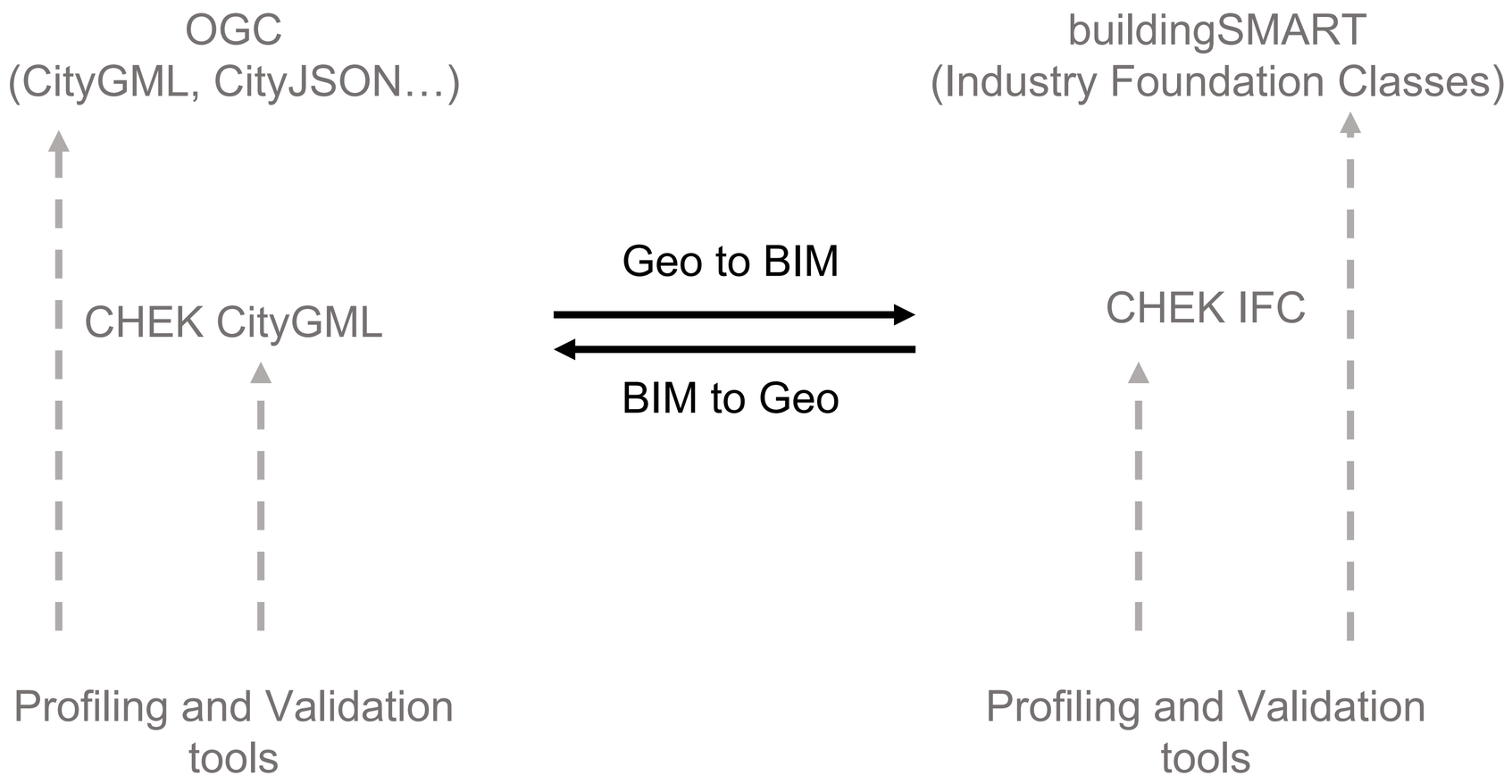

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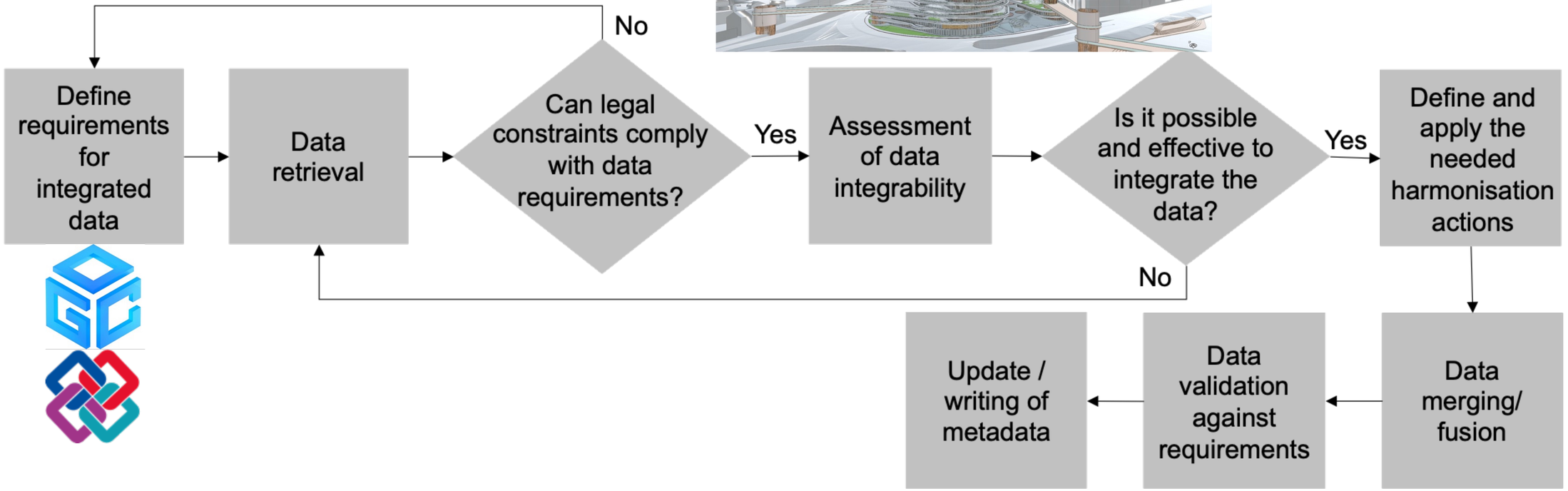
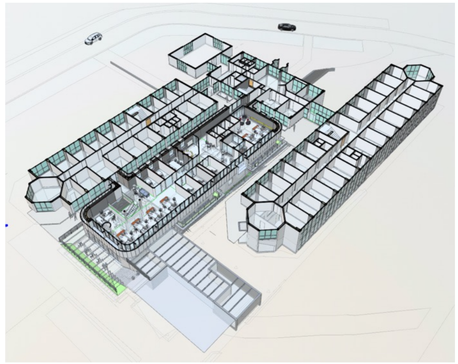
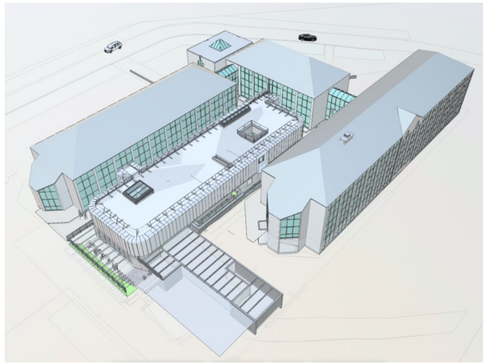
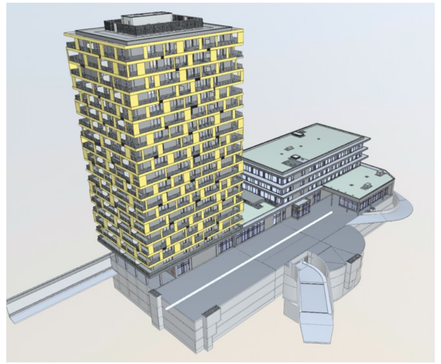








Coming/ongoing GeoBIM sandardisation actions

CHEK Standard best practice about Geo and BIM integration

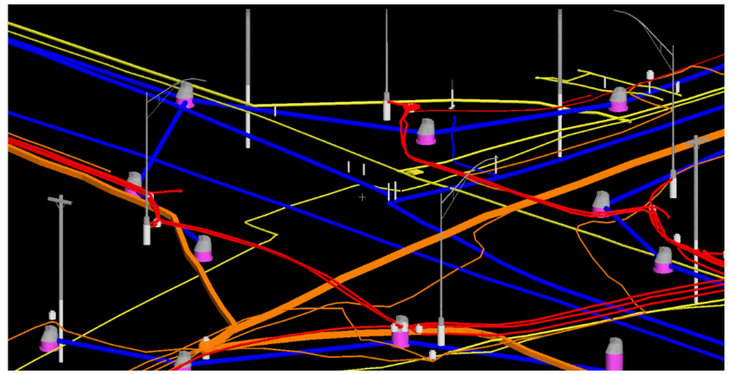
buildingSMART-OGC joint GeoBIM working group led by Jagannath Mallela

OGC GeoBIM related Domain Working Groups and Standard Working Groups

- 3D Information Management DWG
- Digital twin DWG
- Geotech SWG
- Model for Underground Data Definition and Integration (MUDDI) SWG

Underground Infrastructure Information – Challenges

- Present data quality is poor
  - Different data models
  - Stored in different ways
  - Different geometry and semantics
- Inability to exchange data
  - Maintainers have different purposes
  - Ownership, governance challenges
  - Interoperability issues
- Costs of failures are recognized
  - Routine excavations can be disastrous
  - Inefficiencies in construction
  - Unable to predict cascading failures

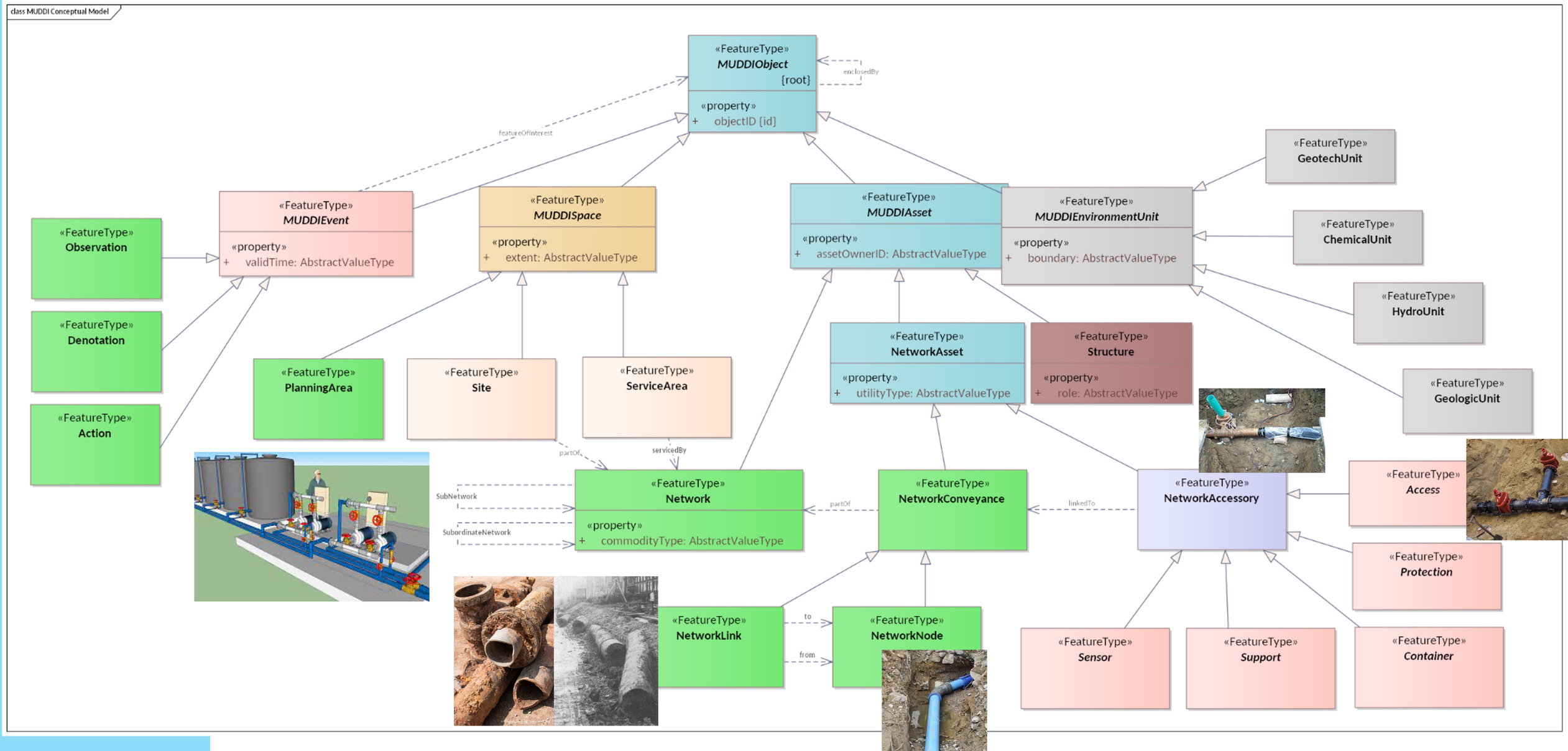


Open Geospatial Consortium

2017 - OGC Underground Concept Development Study Report

A GeoBIM

MUDDI Conceptual model



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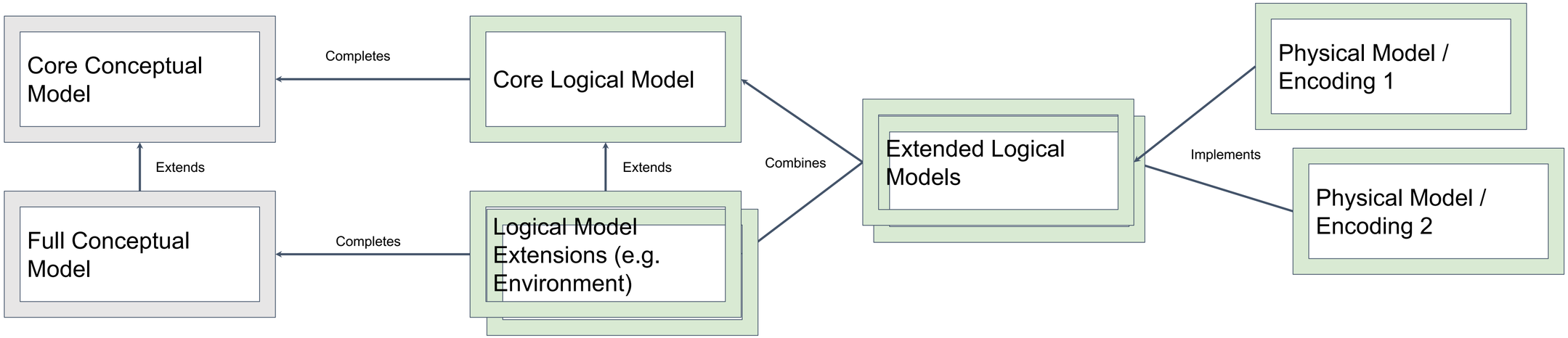
MUDDI Roadmap

Model Driven Specification Development:

- UML Conceptual Model → OGC Standard (2023)
- UML Logical Models → Schema encodings (JSON-FG, CityGML, SF-SQL, 3D Tiles, IFC)



- Conceptual model (entities and relationships) -> 1-way interoperability
- Logical model (completed attributes & datatypes) -> 2-way interoperability
- Physical model (implemented encoding) -> platform interoperability

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Thank you for your attention!

Francesca Noardo
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This project has partially received funding from the European Union's Horizon Europe programme under Grant Agreement No.101058559

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