Open Geospatial Consortium

OGC Geotech Interoperability Experiment

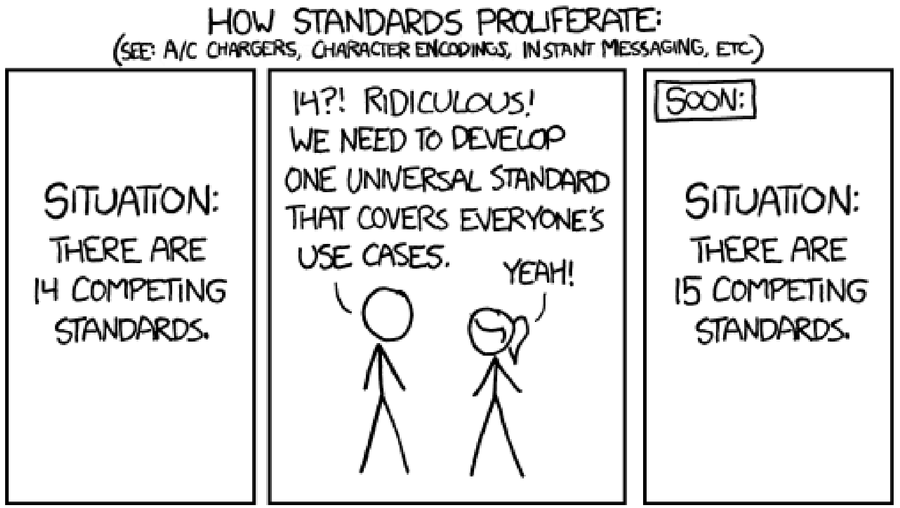
ISSMGE TC222 - 1st workshop

Mickaël Beaufils (BRGM)

14 September 2022

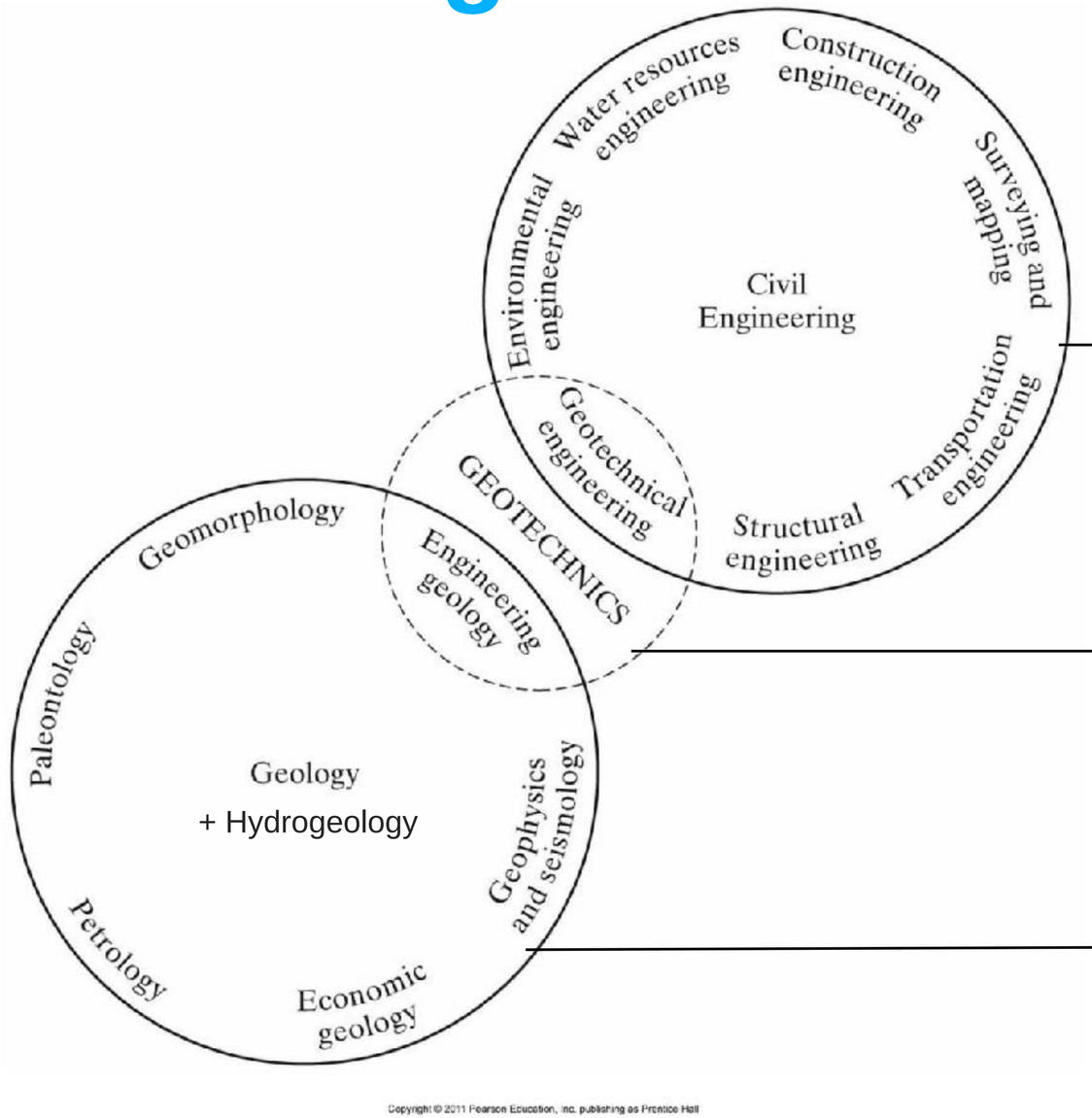
What is Geotech Interoperability Experiment?

- An effort to federate the geotechnical community around standards
  - Enhance existing standards



- An activity hosted by the Open Geospatial Consortium (OGC)
  - Started on February 2022
  - Estimated end in mid 2023

Motivation: Digital continuity for geotech



buildingSMART International — IFC

AGS — .ags

DiGGS DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS — diggsml

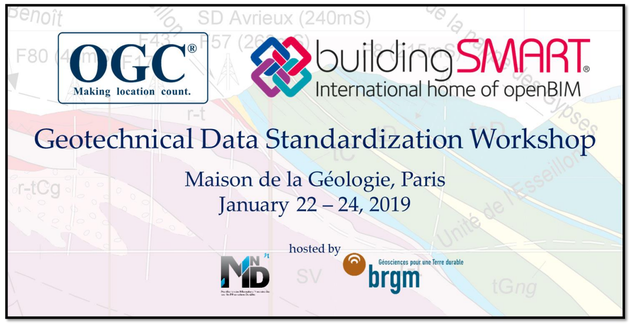
IUGS International Union of Geological Sciences; CGI Commission for the Management and Application of Geoscience Information — GeoSciML

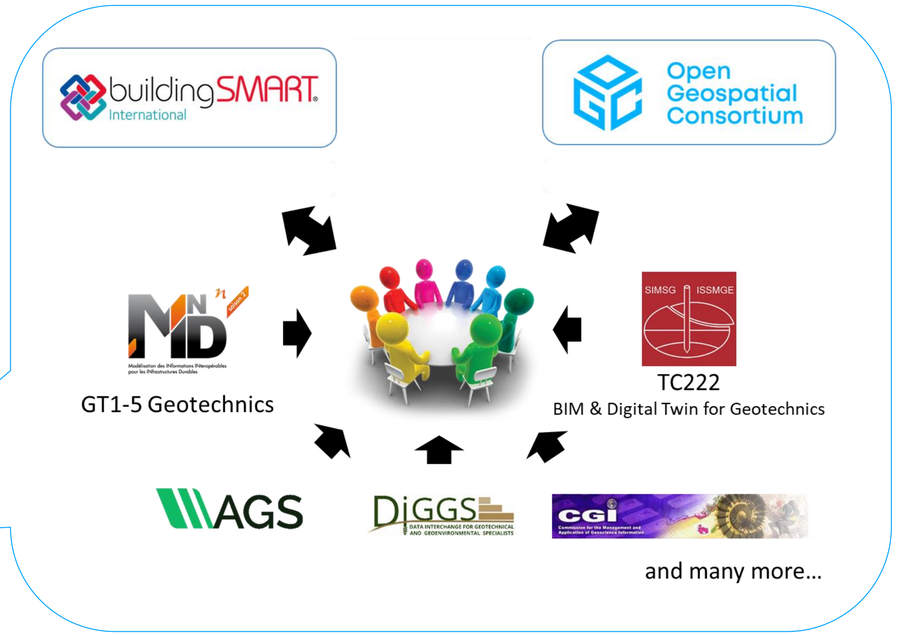
Open Geospatial Consortium — GroundWaterML2

NB: Non exhaustive list of existing formats and standards

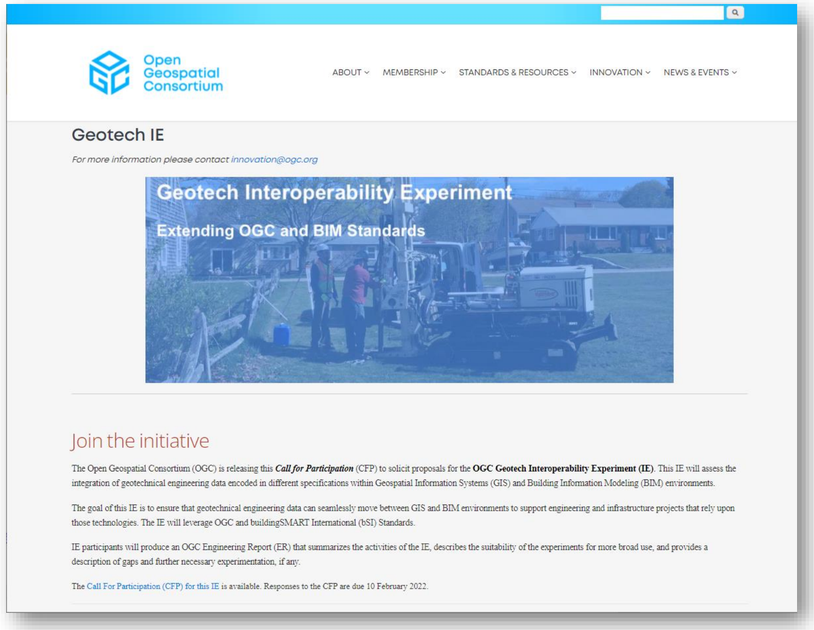
The origin of the Geotech IE

January 2019



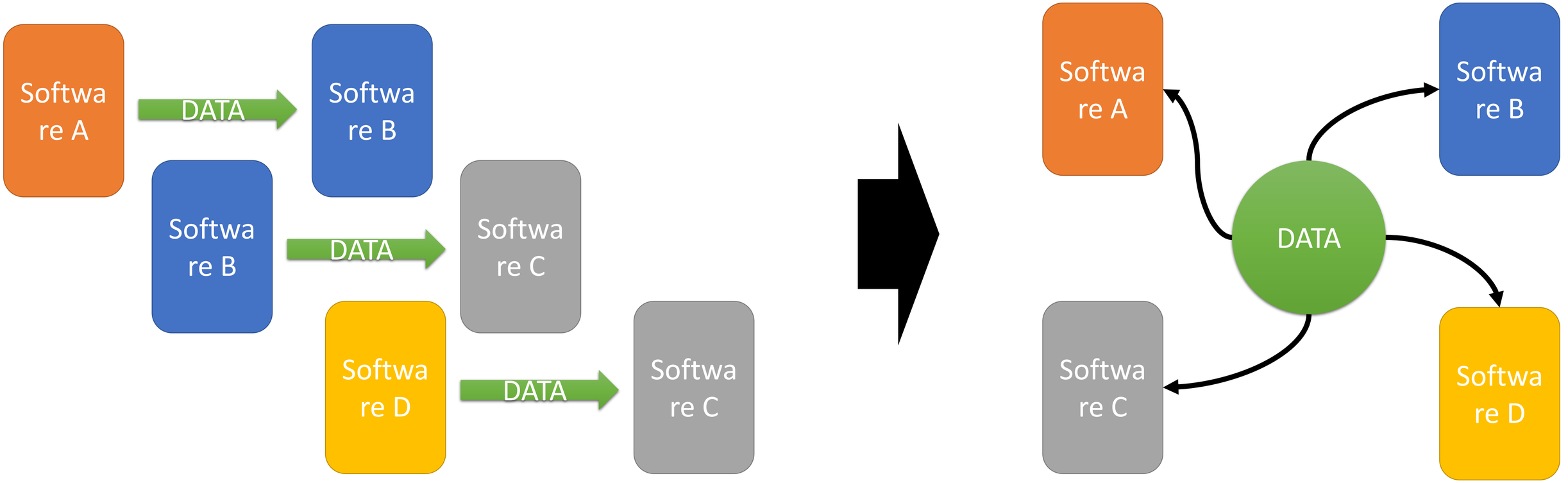


January 2022

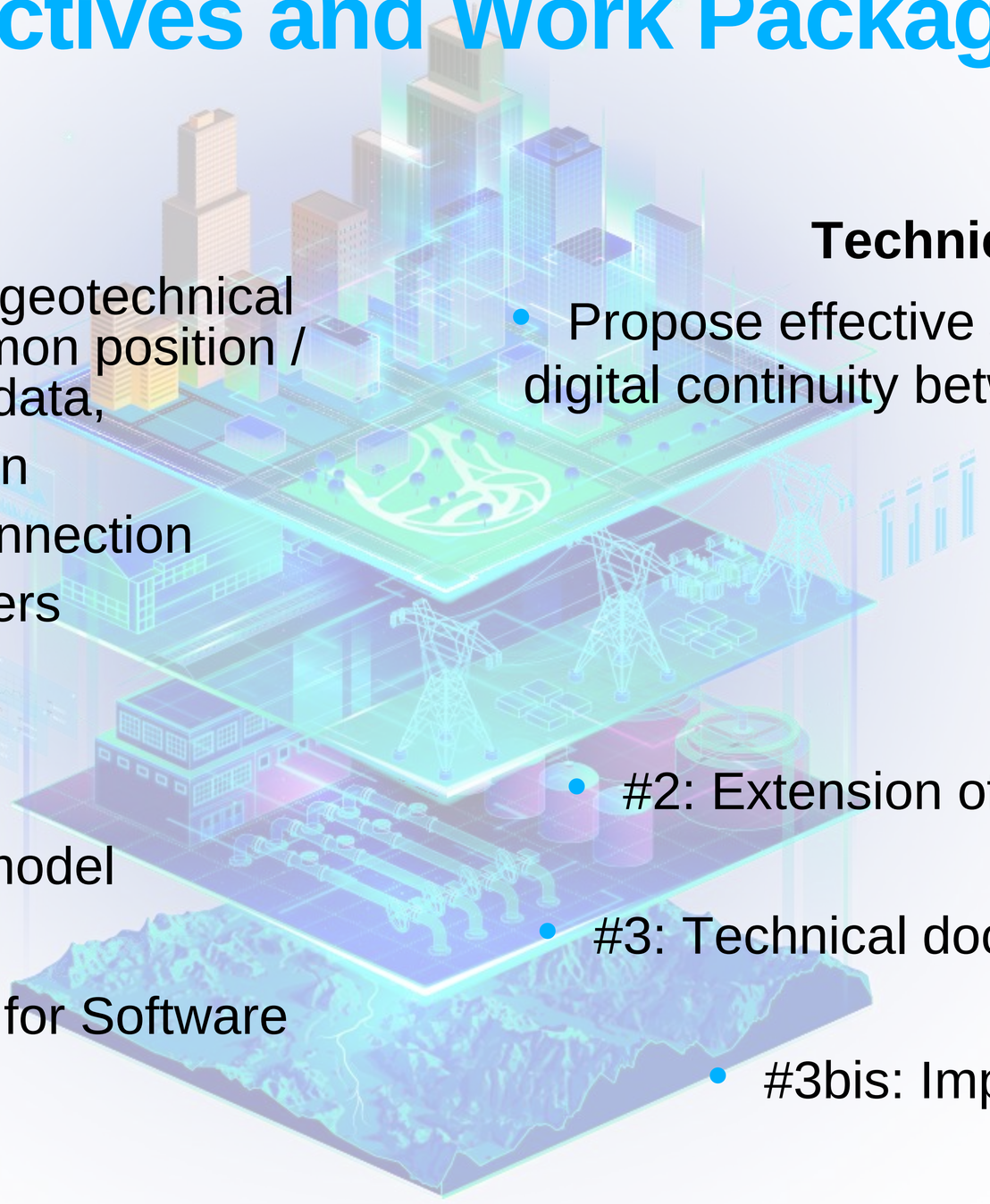


Targetting FAIR Geotech data

- Findable, Accessible, Interoperable and Reusable Data



Geotech IE objectives and Work Packages (reminder)



Community oriented goals

- Contribute to federate the geotechnical community around a common position / proposal for geotechnical data,
  - Scientific – IT connection
  - BIM – GIS and more connection
  - Users – Solution providers connection

Work packages:

- #1: Common conceptual model
- #4: Technical paper
- #5: Implementation Guide for Software Vendors

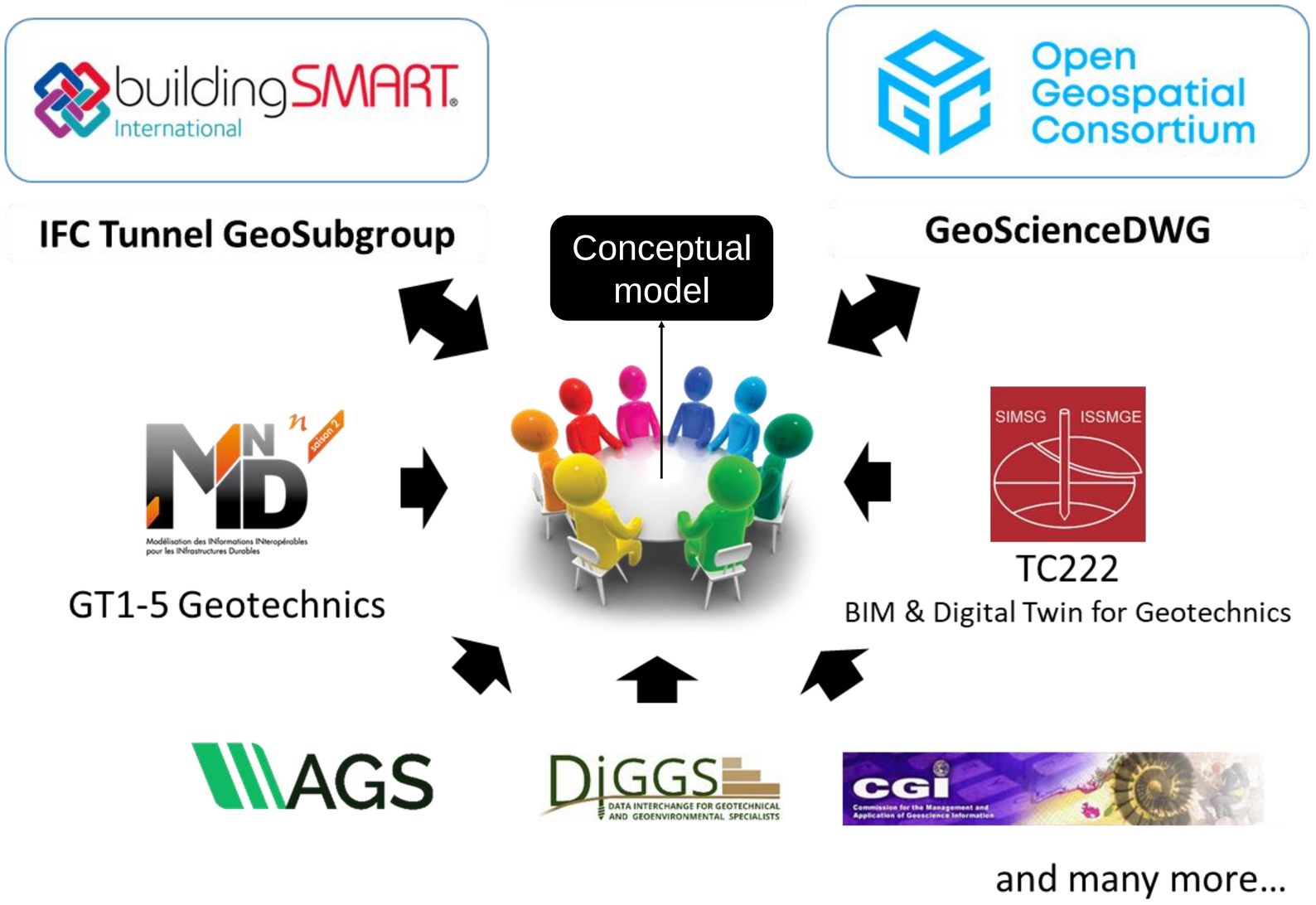
Technical oriented goals

- Propose effective solutions to enable digital continuity between GIS and BIM

Work packages:

- #2: Extension of OGC Geoscience standards,
- #3: Technical documentation on the use of OGC APIs
- #3bis: Implementation forum

#1: Common conceptual model



- Conceptual model:
  - Technology agnostic
  - Base for all implementations

#1: Common conceptual model - Usage

Based on existing working groups / organizations on February 2022

buildingSMART International

Lead: IFC Tech Team

IFC Implementation

Is realized by

buildingSMART International

Lead: IFC Tunnel Geosubgroup

bSI Conceptual Model for Geotechnics

Is realized by

Open Geospatial Consortium

Lead: GeoSciML SWG, GWML2 SWG, etc…

OGC Logical model

Is realized by

Open Geospatial Consortium

Lead: GeoScienceDWG

CGI Commission for the Management and Application of Geoscience Information

OGC Conceptual Model for Geotechnics

Is realized by

AGS

DIGGS DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

…

Is realized by

Common Conceptual model for Geotechnics

SIMSG ISSMGE

ISSMGE TC222

Geotechnical BIM & Digital Twins

As representative of FedIGS

FedIGS

SIMSG ISSMGE

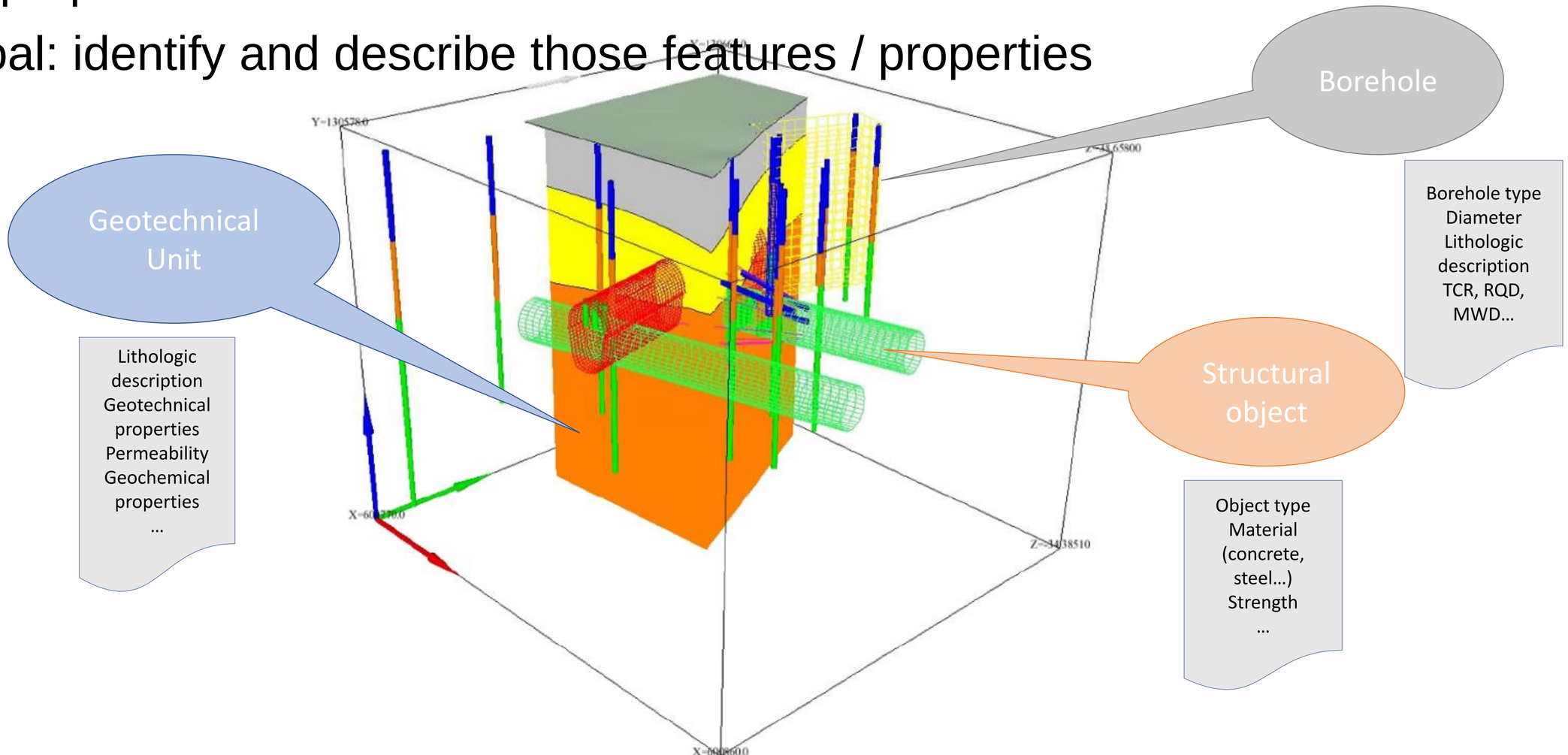
ENGEOL

ISRM

igs

Rationale

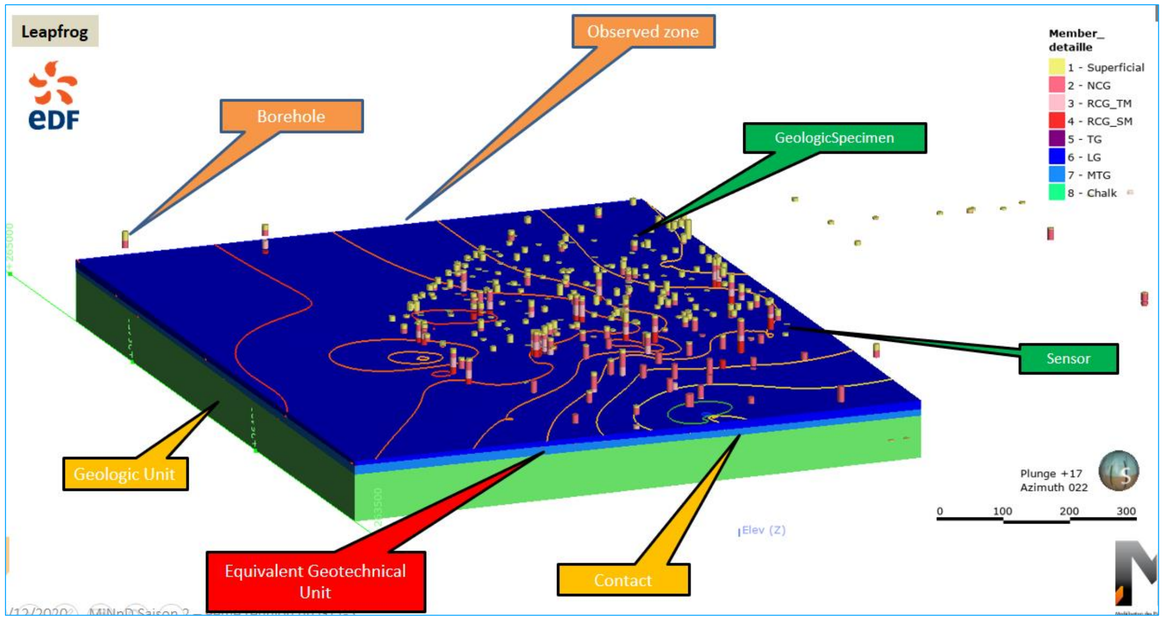
- A BIM model is composed of objects or features associated to attributes or properties
- Goal: identify and describe those features / properties

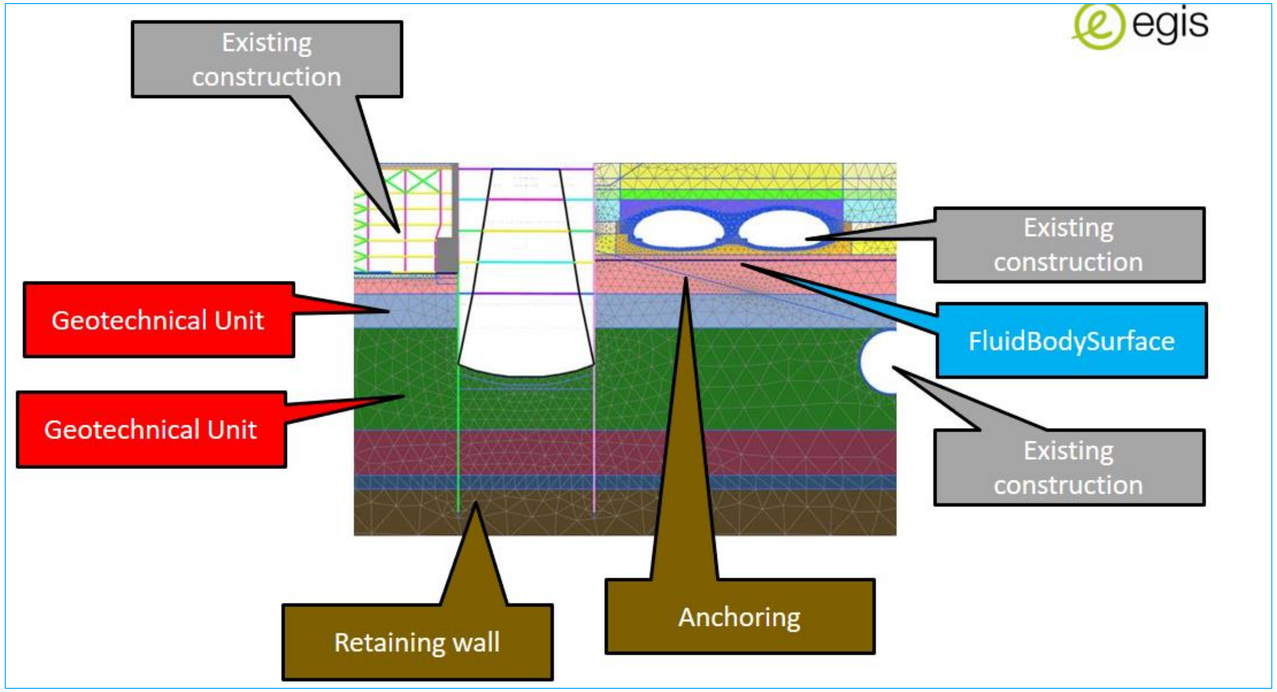


Objects identification

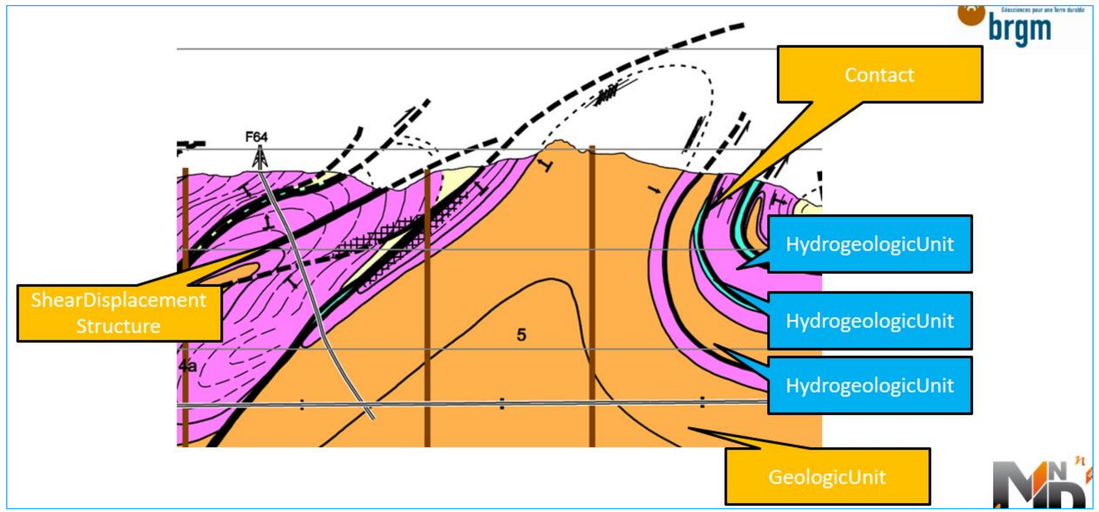
Courtesy of the MINnD WG1-5

3D geological model including boreholes





2D geotechnical model (for finite element calculation)

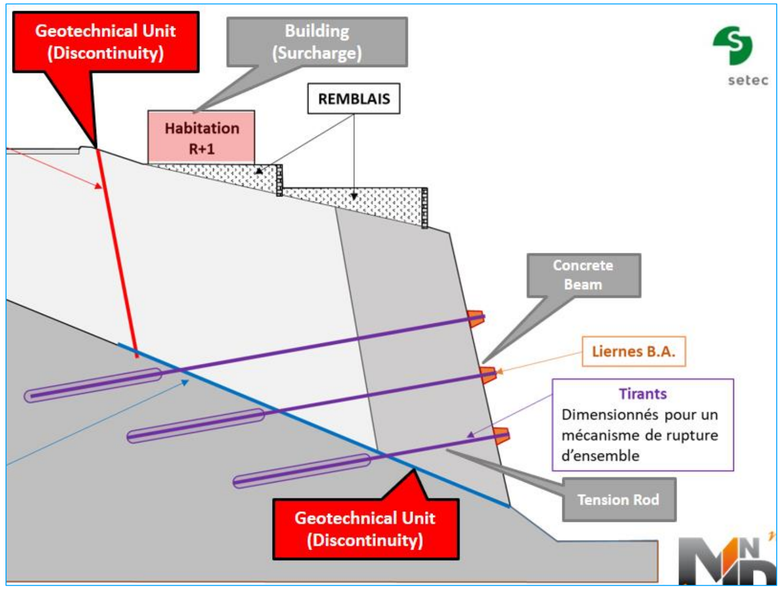


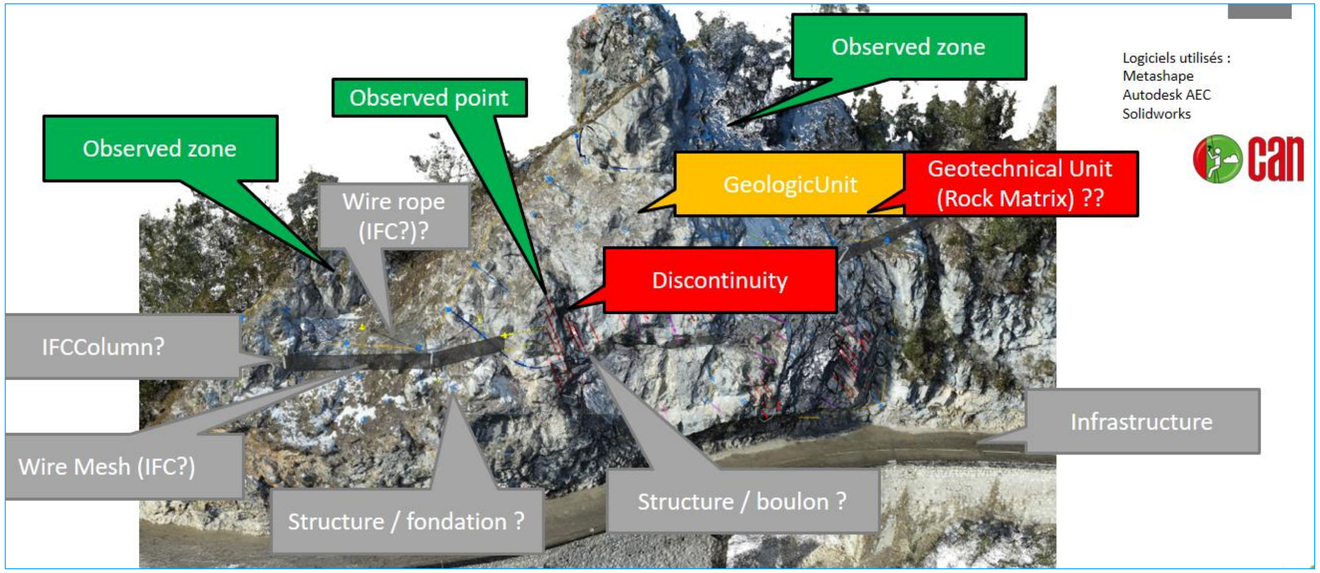
2D geological / hydrogeological model

Objects identification

Courtesy of the MINnD WG1-5

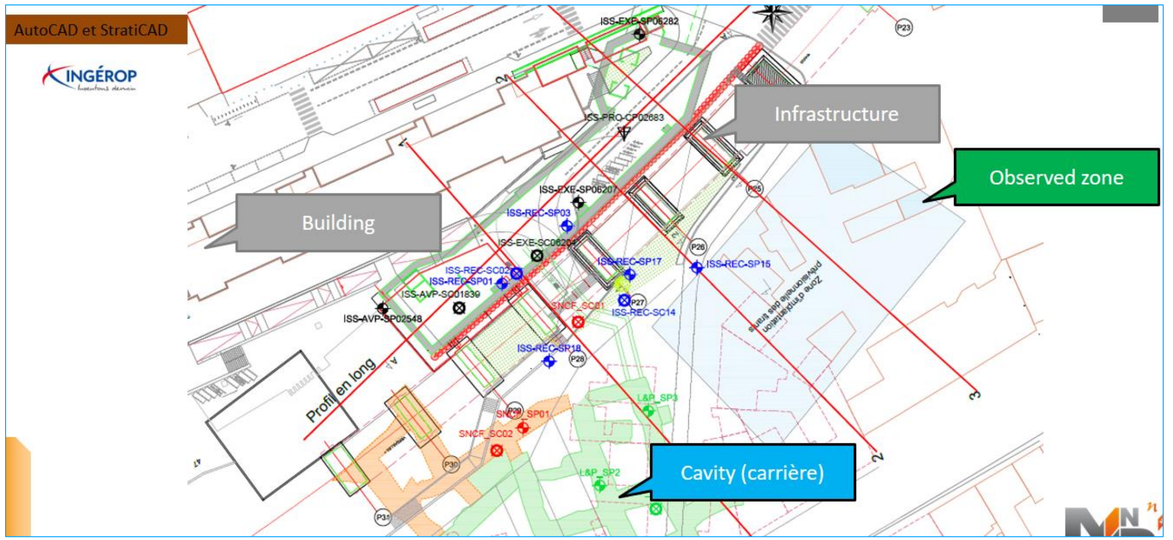
2D geotechnical model including design structures





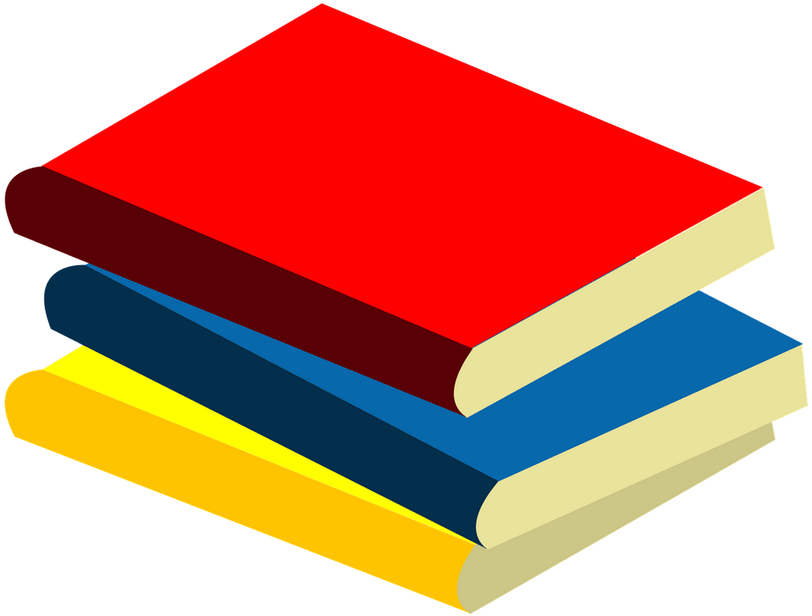
3D view including design structures

2D drawing including the project, neighbouring structures and boreholes



Geotechnics is « simple » as A, B, C

- Following the terminology from AFTES GT32 (also used in bSI IFC Tunnel WG)
  - AFTES = French Association of Tunnel and Underground Space



Book C: Design report: « Projection »

Book B: Models and interpretations

Book A: Observations and measurements

- Book C depends on Book B which depends on Book A

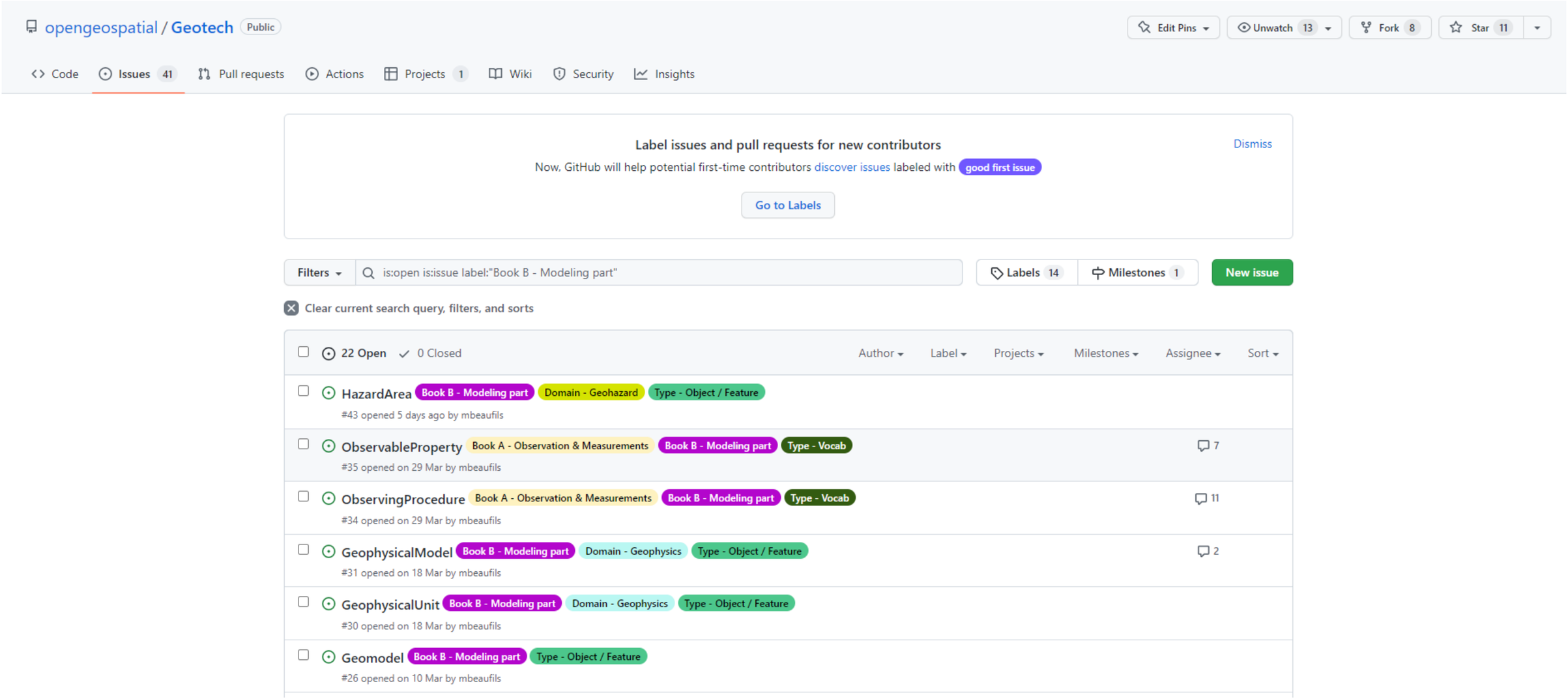
Contents of each book
(based on current discussion and cover intentions by the standards / formats)

	Objects	Associated properties
Book A AGS DiGGS Open Geospatial Consortium buildingSMART International	**Observation Supports or Sampling Features** Borehole, Material Sample, Trial Pit, Observed Zone	**Observations and measurements** In-situ tests Laboratory tests Monitoring
Book B Open Geospatial Consortium buildingSMART International AGSi *	**Models and their (possible) components** GeologicUnit, Fault, Contact, Fold HydrogeologicUnit, FluidBody, FluidBodySurface, WaterBody GeotechnicalUnit, Discontinuity, Void HazardArea GeophysicalUnit?	**Interpretations**
Book C Open Geospatial Consortium buildingSMART International	**GeotechSynthesis Model** Alignment, TypicalDesignArea, GeotechnicalZoneOfInfluence	**Interpretations / Projections**

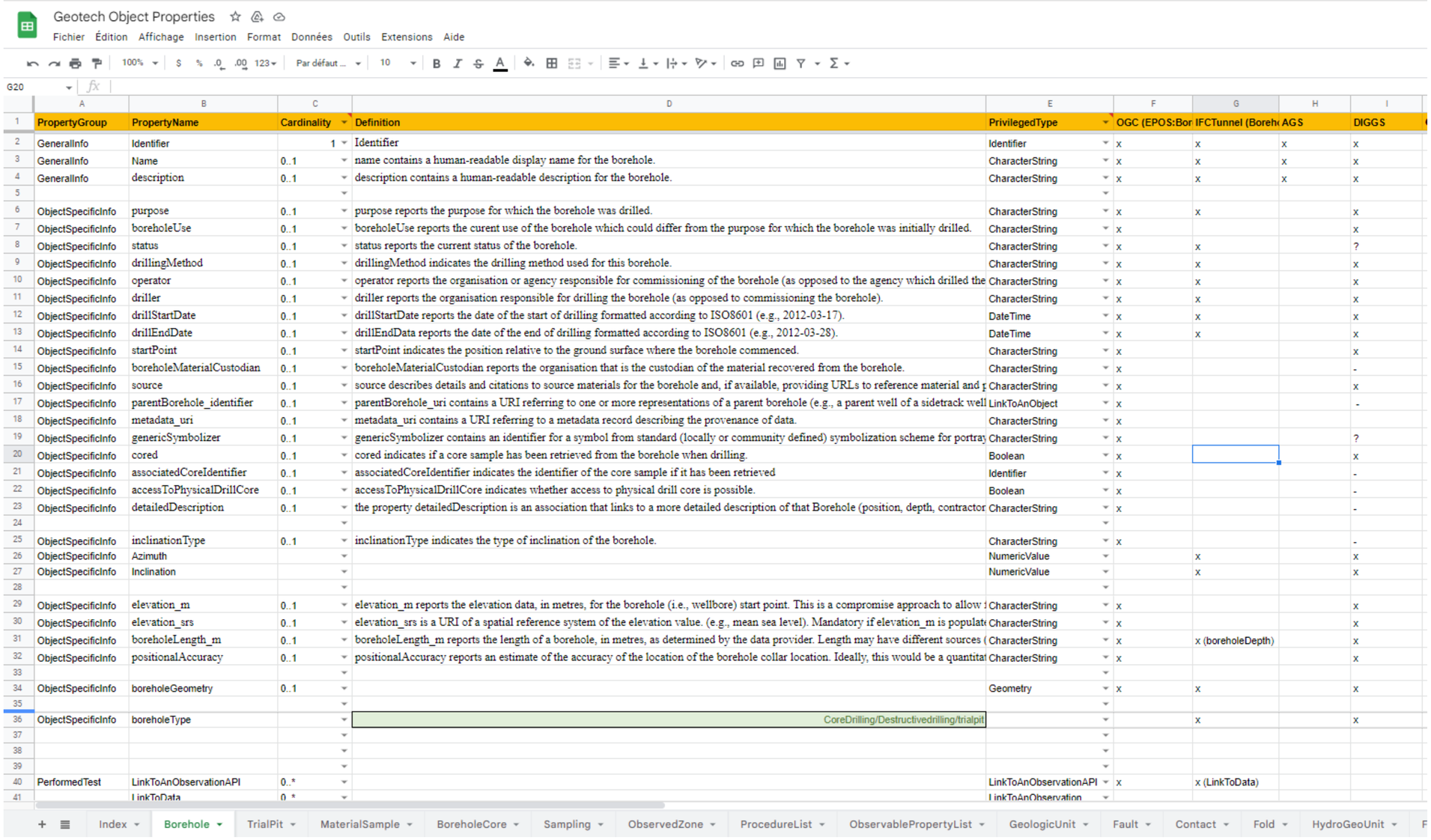
* partial cover

Objects definition

https://github.com/opengeospatial/Geotech/issues



Objects attributes (and alignment)



Geotech Object Properties

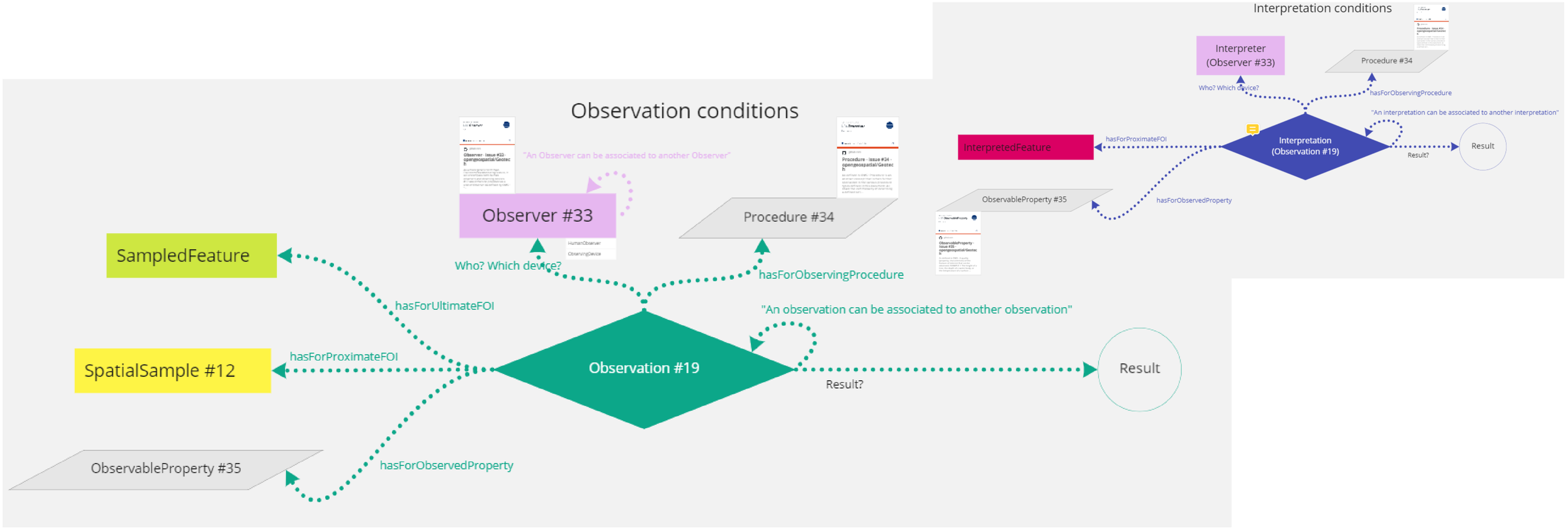
Fichier Édition Affichage Insertion Format Données Outils Extensions Aide

	A	B	C	D	E	F	G	H	I
1	PropertyGroup	PropertyName	Cardinality	Definition	PrivilegedType	OGC (EPOS:Bor	IFCTunnel (Boreh	AGS	DIGGS
2	GeneralInfo	Identifier	1	Identifier	Identifier	x	x	x	x
3	GeneralInfo	Name	0..1	name contains a human-readable display name for the borehole.	CharacterString	x	x	x	x
4	GeneralInfo	description	0..1	description contains a human-readable description for the borehole.	CharacterString	x	x	x	x
5									
6	ObjectSpecificInfo	purpose	0..1	purpose reports the purpose for which the borehole was drilled.	CharacterString	x	x		x
7	ObjectSpecificInfo	boreholeUse	0..1	boreholeUse reports the curent use of the borehole which could differ from the purpose for which the borehole was initially drilled.	CharacterString	x			x
8	ObjectSpecificInfo	status	0..1	status reports the current status of the borehole.	CharacterString	x	x		?
9	ObjectSpecificInfo	drillingMethod	0..1	drillingMethod indicates the drilling method used for this borehole.	CharacterString	x	x		x
10	ObjectSpecificInfo	operator	0..1	operator reports the organisation or agency responsible for commissioning of the borehole (as opposed to the agency which drilled the	CharacterString	x	x		x
11	ObjectSpecificInfo	driller	0..1	driller reports the organisation responsible for drilling the borehole (as opposed to commissioning the borehole).	CharacterString	x	x		x
12	ObjectSpecificInfo	drillStartDate	0..1	drillStartDate reports the date of the start of drilling formatted according to ISO8601 (e.g., 2012-03-17).	DateTime	x	x		x
13	ObjectSpecificInfo	drillEndDate	0..1	drillEndData reports the date of the end of drilling formatted according to ISO8601 (e.g., 2012-03-28).	DateTime	x	x		x
14	ObjectSpecificInfo	startPoint	0..1	startPoint indicates the position relative to the ground surface where the borehole commenced.	CharacterString	x			x
15	ObjectSpecificInfo	boreholeMaterialCustodian	0..1	boreholeMaterialCustodian reports the organisation that is the custodian of the material recovered from the borehole.	CharacterString	x			-
16	ObjectSpecificInfo	source	0..1	source describes details and citations to source materials for the borehole and, if available, providing URLs to reference material and p	CharacterString	x			x
17	ObjectSpecificInfo	parentBorehole_identifier	0..1	parentBorehole_uri contains a URI referring to one or more representations of a parent borehole (e.g., a parent well of a sidetrack well	LinkToAnObject	x			-
18	ObjectSpecificInfo	metadata_uri	0..1	metadata_uri contains a URI referring to a metadata record describing the provenance of data.	CharacterString	x			
19	ObjectSpecificInfo	genericSymbolizer	0..1	genericSymbolizer contains an identifier for a symbol from standard (locally or community defined) symbolization scheme for portray	CharacterString	x			?
20	ObjectSpecificInfo	cored	0..1	cored indicates if a core sample has been retrieved from the borehole when drilling.	Boolean	x			x
21	ObjectSpecificInfo	associatedCoreIdentifier	0..1	associatedCoreIdentifier indicates the identifier of the core sample if it has been retrieved	Identifier	x			-
22	ObjectSpecificInfo	accessToPhysicalDrillCore	0..1	accessToPhysicalDrillCore indicates whether access to physical drill core is possible.	Boolean	x			-
23	ObjectSpecificInfo	detailedDescription	0..1	the property detailedDescription is an association that links to a more detailed description of that Borehole (position, depth, contractor	CharacterString	x			-
24									
25	ObjectSpecificInfo	inclinationType	0..1	inclinationType indicates the type of inclination of the borehole.	CharacterString	x			-
26	ObjectSpecificInfo	Azimuth			NumericValue		x		x
27	ObjectSpecificInfo	Inclination			NumericValue		x		x
28									
29	ObjectSpecificInfo	elevation_m	0..1	elevation_m reports the elevation data, in metres, for the borehole (i.e., wellbore) start point. This is a compromise approach to allow	CharacterString	x			x
30	ObjectSpecificInfo	elevation_srs	0..1	elevation_srs is a URI of a spatial reference system of the elevation value. (e.g., mean sea level). Mandatory if elevation_m is populate	CharacterString	x			x
31	ObjectSpecificInfo	boreholeLength_m	0..1	boreholeLength_m reports the length of a borehole, in metres, as determined by the data provider. Length may have different sources (	CharacterString	x	x (boreholeDepth)		x
32	ObjectSpecificInfo	positionalAccuracy	0..1	positionalAccuracy reports an estimate of the accuracy of the location of the borehole collar location. Ideally, this would be a quantitat	CharacterString	x			x
33									
34	ObjectSpecificInfo	boreholeGeometry	0..1		Geometry	x	x		x
35									
36	ObjectSpecificInfo	boreholeType		CoreDrilling/Destructivedrilling/trialpit			x		x
37									
38									
39									
40	PerformedTest	LinkToAnObservationAPI	0..*		LinkToAnObservationAPI	x	x (LinkToData)		
41		LinkToData	0..*		LinkToAnObservation				

Index | Borehole | TrialPit | MaterialSample | BoreholeCore | Sampling | ObservedZone | ProcedureList | ObservablePropertyList | GeologicUnit | Fault | Contact | Fold | HydroGeoUnit

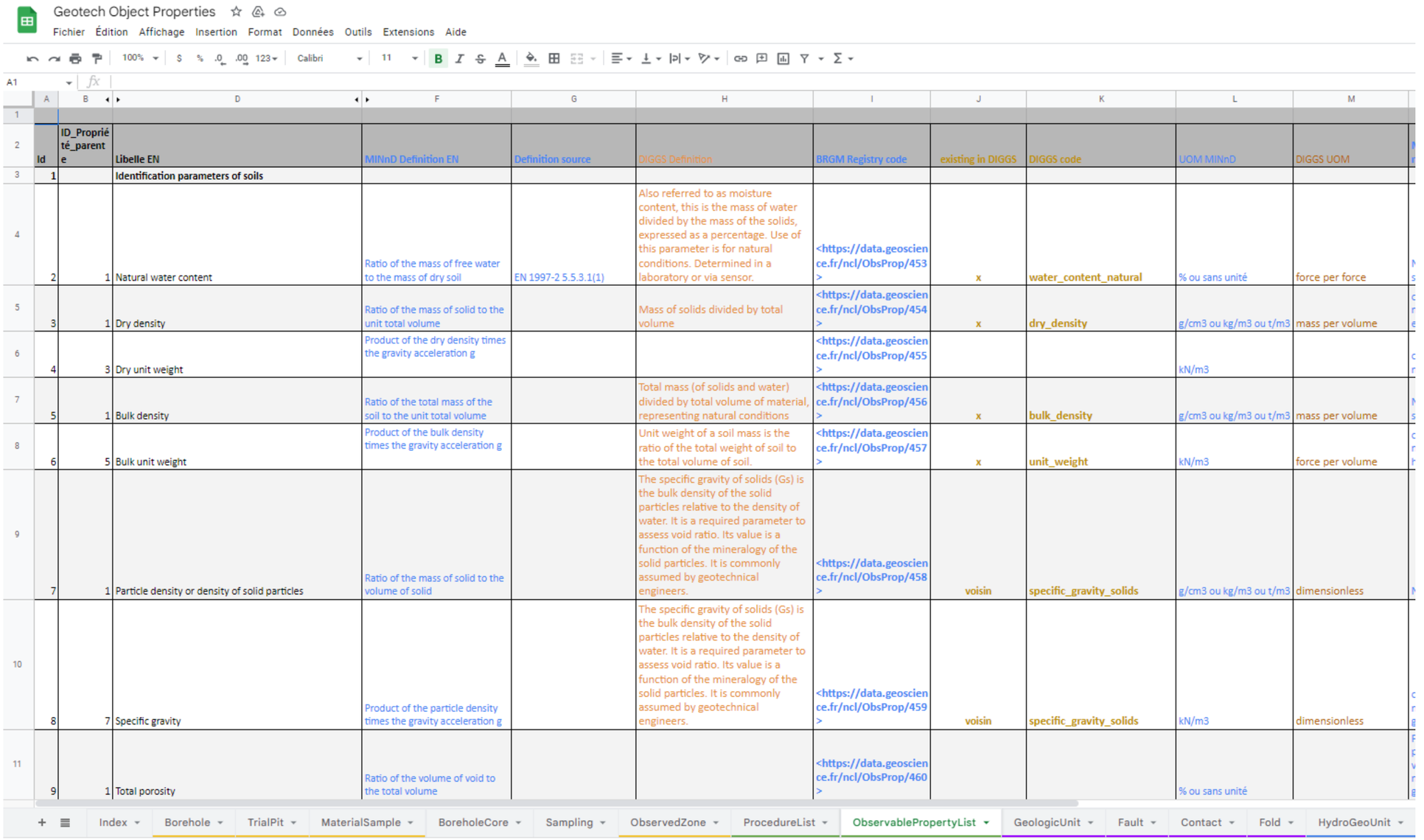
Observations, measurements and interpretations

- Proposal based on the Observation Measurements and Samples « pattern » (ISO19156 v2 proposal)
  - Application for observations, measurements AND interpretation



Semantics alignment

- Topics:
  - Observable Properties
  - Interpreted Properties
  - Procedure
- Sources:
  - MINnD
  - DIGGS
  - AGS



Geotech Object Properties

Fichier Édition Affichage Insertion Format Données Outils Extensions Aide

Id	ID_Propriété_parente	Libelle EN	MINnD Definition EN	Definition source	DIGGS Definition	BRGM Registry code	existing in DIGGS	DIGGS code	UOM MINnD	DIGGS UOM
1		Identification parameters of soils								
2	1	Natural water content	Ratio of the mass of free water to the mass of dry soil	EN 1997-2 5.5.3.1(1)	Also referred to as moisture content, this is the mass of water divided by the mass of the solids, expressed as a percentage. Use of this parameter is for natural conditions. Determined in a laboratory or via sensor.	<https://data.geoscience.fr/ncl/ObsProp/453>	x	water_content_natural	% ou sans unité	force per force
3	1	Dry density	Ratio of the mass of solid to the unit total volume		Mass of solids divided by total volume	<https://data.geoscience.fr/ncl/ObsProp/454>	x	dry_density	g/cm3 ou kg/m3 ou t/m3	mass per volume
4	3	Dry unit weight	Product of the dry density times the gravity acceleration g			<https://data.geoscience.fr/ncl/ObsProp/455>			kN/m3	
5	1	Bulk density	Ratio of the total mass of the soil to the unit total volume		Total mass (of solids and water) divided by total volume of material, representing natural conditions	<https://data.geoscience.fr/ncl/ObsProp/456>	x	bulk_density	g/cm3 ou kg/m3 ou t/m3	mass per volume
6	5	Bulk unit weight	Product of the bulk density times the gravity acceleration g		Unit weight of a soil mass is the ratio of the total weight of soil to the total volume of soil.	<https://data.geoscience.fr/ncl/ObsProp/457>	x	unit_weight	kN/m3	force per volume
7	1	Particle density or density of solid particles	Ratio of the mass of solid to the volume of solid		The specific gravity of solids (Gs) is the bulk density of the solid particles relative to the density of water. It is a required parameter to assess void ratio. Its value is a function of the mineralogy of the solid particles. It is commonly assumed by geotechnical engineers.	<https://data.geoscience.fr/ncl/ObsProp/458>	voisin	specific_gravity_solids	g/cm3 ou kg/m3 ou t/m3	dimensionless
8	7	Specific gravity	Product of the particle density times the gravity acceleration g		The specific gravity of solids (Gs) is the bulk density of the solid particles relative to the density of water. It is a required parameter to assess void ratio. Its value is a function of the mineralogy of the solid particles. It is commonly assumed by geotechnical engineers.	<https://data.geoscience.fr/ncl/ObsProp/459>	voisin	specific_gravity_solids	kN/m3	dimensionless
9	1	Total porosity	Ratio of the volume of void to the total volume			<https://data.geoscience.fr/ncl/ObsProp/460>			% ou sans unité	

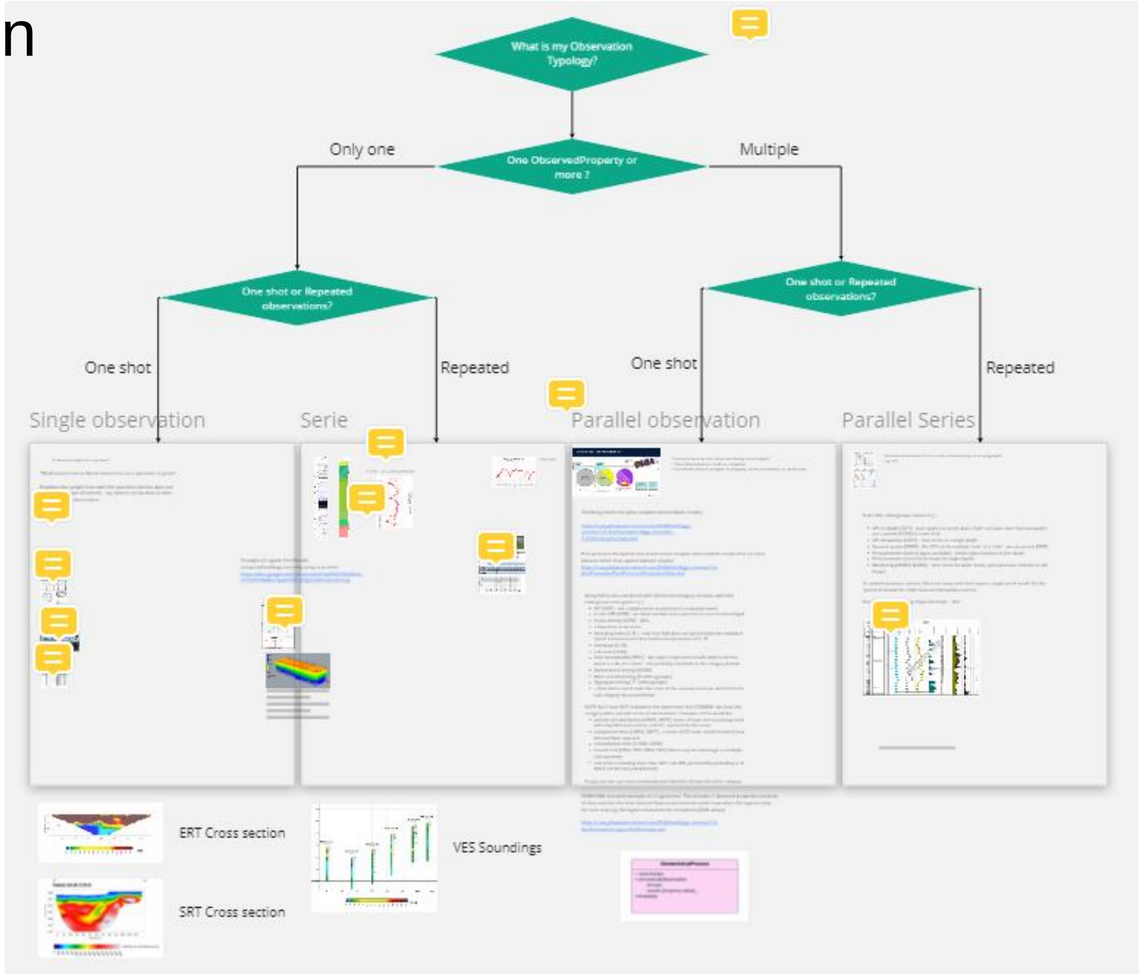
Index | Borehole | TrialPit | MaterialSample | BoreholeCore | Sampling | ObservedZone | ProcedureList | ObservablePropertyList | GeologicUnit | Fault | Contact | Fold | HydroGeoUnit

Observations, measurements and interpretations (on-going discussions)

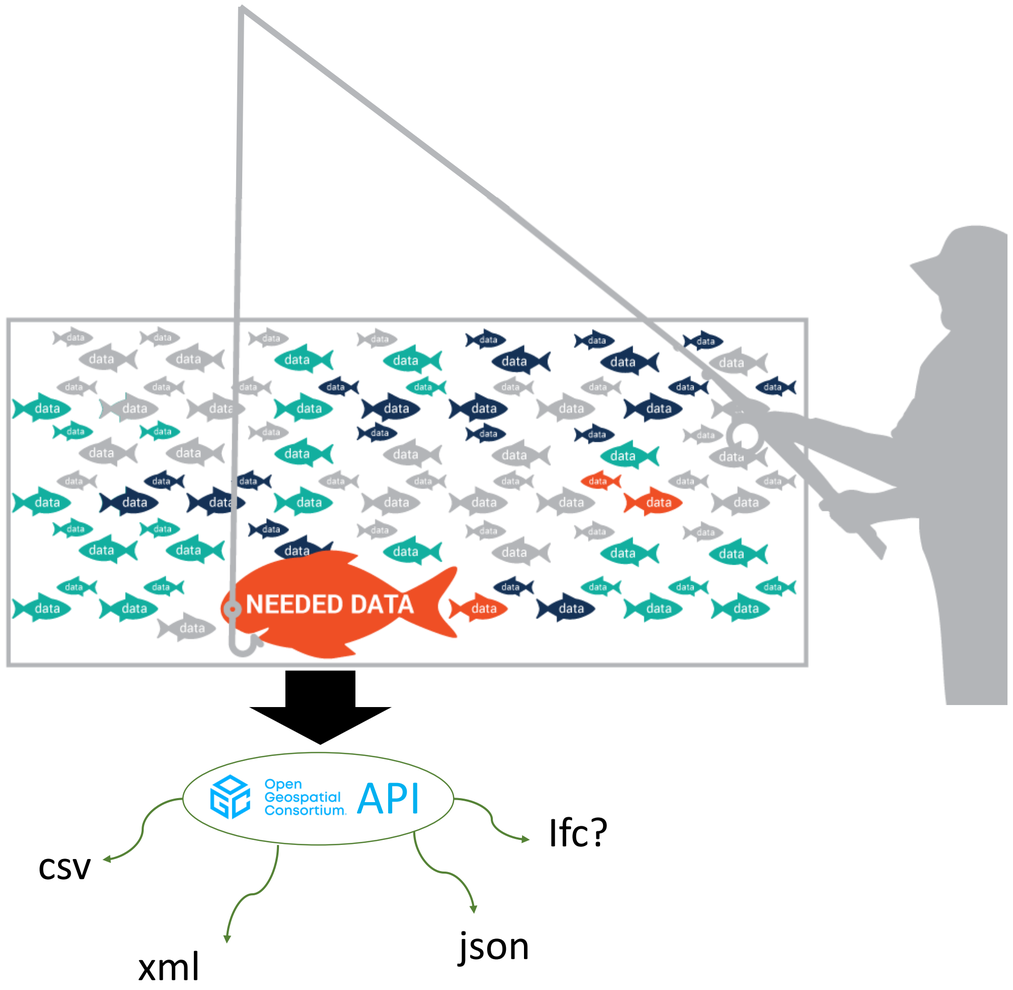
- How to deal with complex Procedure?
  - ComplexResult vs ObservationCollection

What goes in to a Geotechnical “Procedure”

- Specification
  - Standard or “recipe” that is followed to produce the observation result(s)
- Metadata
  - Equipment properties
  - Environmental properties
  - Specimen properties
  - ”Event” notes, comments, etc.
- “Intermediate” Observations and results
  - Values of observed properties used to derive the observation result(s)



APIs to deliver Geotech data



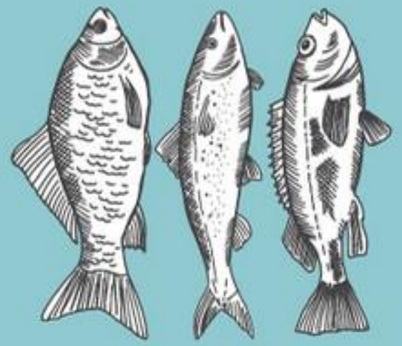
- Intention
  - Be able to discover existing data
  - Be able to get / download them
- Requirement
  - Meta description of data
  - Appropriate data formats for usages
  - Shared data!
- Proposed solution
  - Data discovery: Catalogs + search functionnality
  - Data accessibility: OGC APIs

A fisherman's dream…

Different recipe of geotechnical data

Au BON API tit

by Open Geospatial Consortium



BEST IN TOWN

À la <GeoSciML/>

- *Xml*
- *Json*
- *Json-LD*

À la DIGGS

DATA INTERCHANGE FOR GEOTECHNICAL AND GEOENVIRONMENTAL SPECIALISTS

- *Xml*
- *Json*

À la AGS

- *Csv*
- *Json*

À la buildingSMART International

- *IFC*

Wrap up

Community oriented goals

- Contribute to federate the geotechnical community around a common position / proposal for geotechnical data,
  - Scientific – IT connection
  - BIM – GIS and more connection
  - Users – Solution providers connection

Technical oriented goals

- Propose effective solutions to enable digital continuity between GIS and BIM

(Main) contribution to ISSMGE TC222 Objective 2

White Paper

Paper objective

This paper exposes a position regarding Digital Continuity for Geotechnics at the BIM era. It introduces challenges and also envisions solutions to address it.

The co-authors listed below share this vision and propose to collaborate to develop or support this initiative.

Co-authors / supporters

Confirmed:

Scott Simmons, OGC, Chief Standards Officer

Richard Petrie, buildingSmart International, Chief Executive

Mickaël Beaufils, BRGM, OGC GeoScience DWG Chair

Michel Rives, Vianova Systems, IFC Tunnel Project Leader

Jonas Weil, IC-Group, IFC Tunnel Geo-Subgroup Leader

Magnus Romoen, NGI, ISSMGE TC222 Chair

Harvey Thorleifson, Minessota Geological Survey, CGI-IUGS Chair

Andrew Hugues, BGS, OGC MUDDI SWG Co-chair

Isabelle Halfon, BRGM, Geotechnical Engineer

Elodie Vautherin, COLAS, Geotechnical Engineer

Pierre Garnier, COLAS, Geotechnical Engineer

Sylvie Bretelle, Geotechnical Engineer

Expected (please feel free to adjust and move to the confirmed section):

Julian Lovell, AGS, Chair

Robert Bachus, DIGGS, Chair

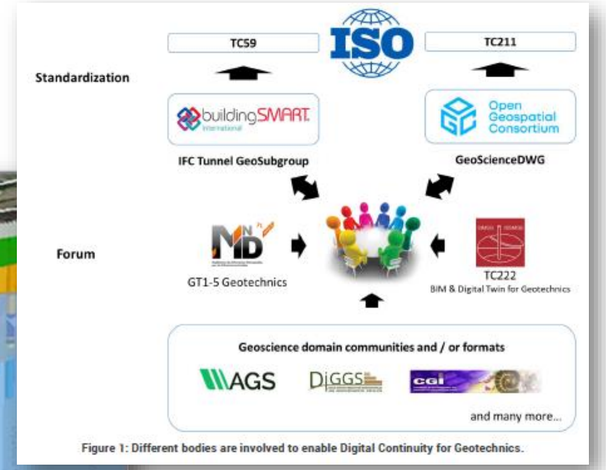
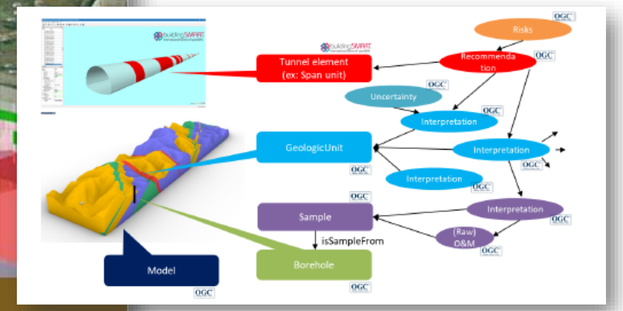


Figure 1: Different bodies are involved to enable Digital Continuity for Geotechnics.



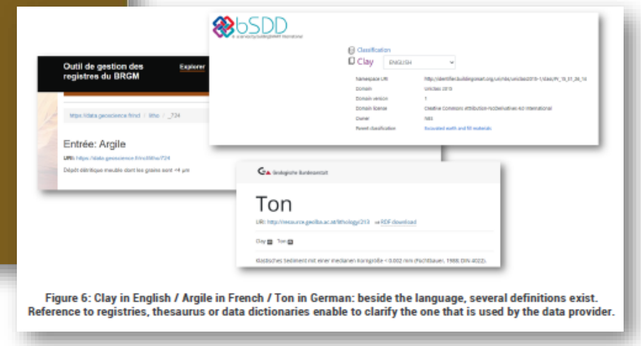


Figure 6: Clay in English / Argile in French / Ton in German: beside the language, several definitions exist. Reference to registries, thesaurus or data dictionaries enable to clarify the one that is used by the data provider.

https://github.com/opengeospatial/Geotech/blob/master/Geotech_IE/white_paper/Digital%20continuity%20for%20Geotechnics%20at%20the%20BIM%20era%20v1RC3.pdf

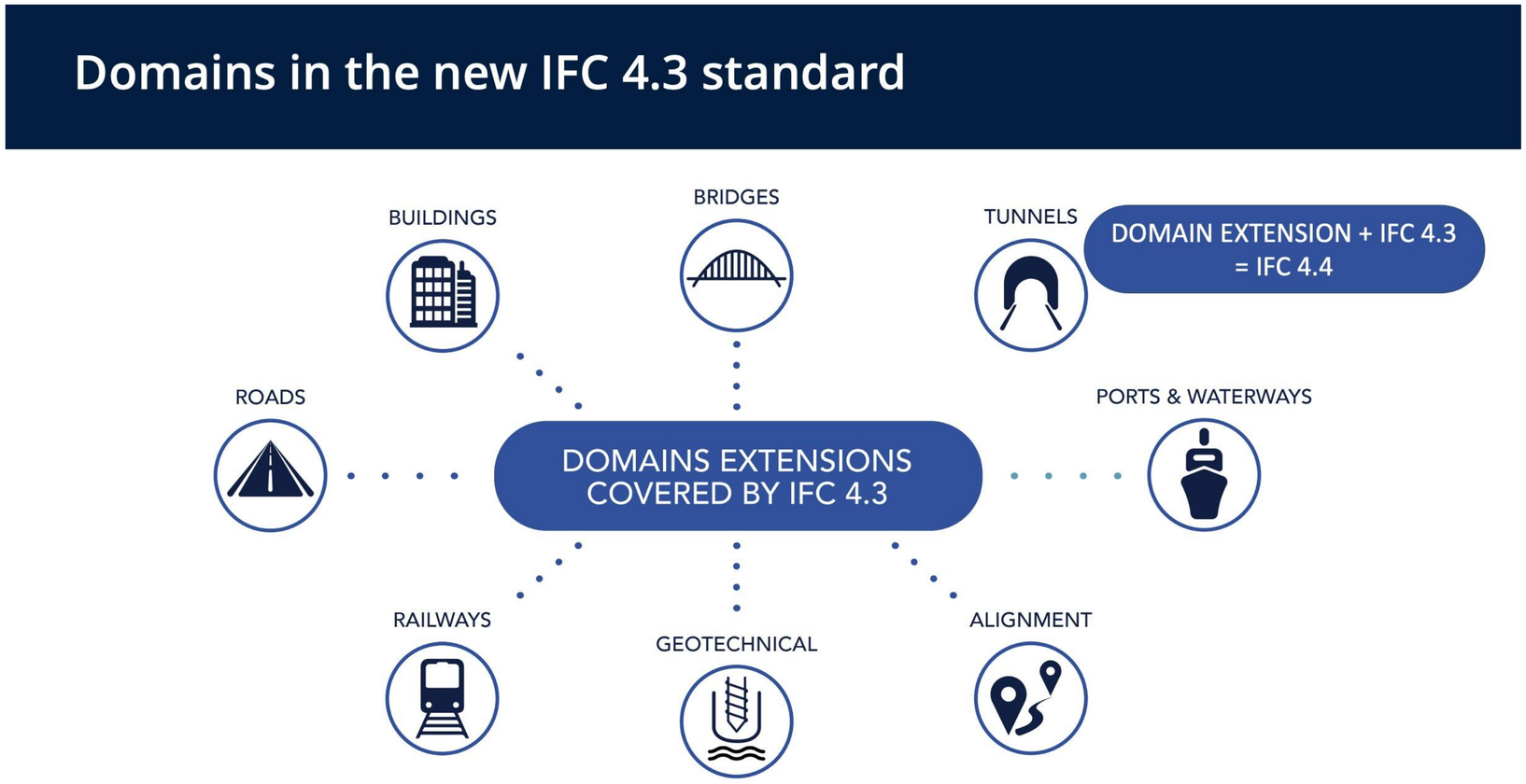
bSI IFC Tunnel project

- Providing extensions to the IFC Schema for describing underground infrastructures
- Also addressing geotechnics
- IFC 4.4 scope:

- geotechnics factual data, interpretation models & voxel representation (conceptual model shared by bSI with OGC GeotechIE project)
- excavation methods, support and lining for underground tunnels & spaces
- ventilation, lighting, firefighting, dewatering, HV/LV provision, evacuation & safety

- Notes on IFC releases:

- IFC4.3 released Aug21. Currently under ISO16739 processing
- IFC4.4 planned for End 22. ISO16739 to follow



- Contact:

Michel Rives – bSI IFC 4.4 project manager (michel.rives@vianova-systems.eu)
Jonas Weil – Geotech Team Lead (j.weil@ic-group.org)

Thanks for your attention

Contact: m.beaufils@brgm.fr