Open Geospatial Consortium

GeotechIE report

The 125th OGC Member Meeting

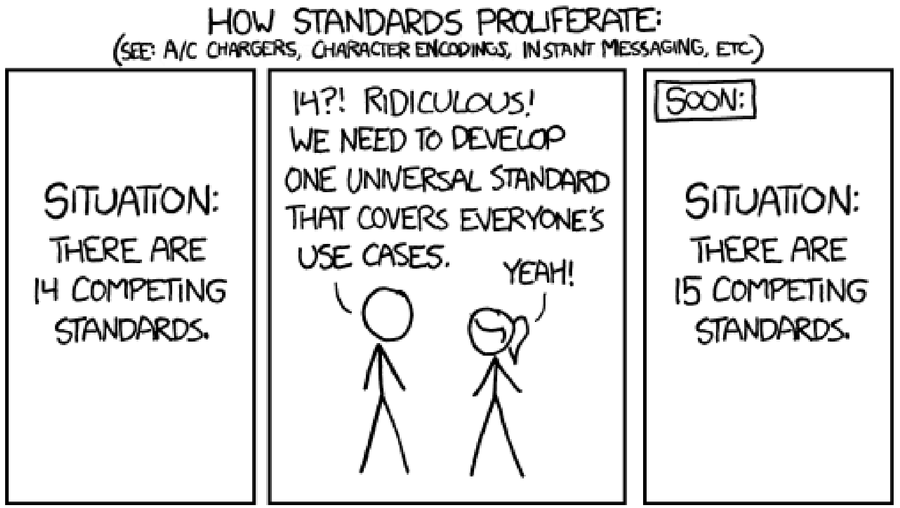
With the support of

esa

Mickael Beaufils, BRGM
22 February 2023

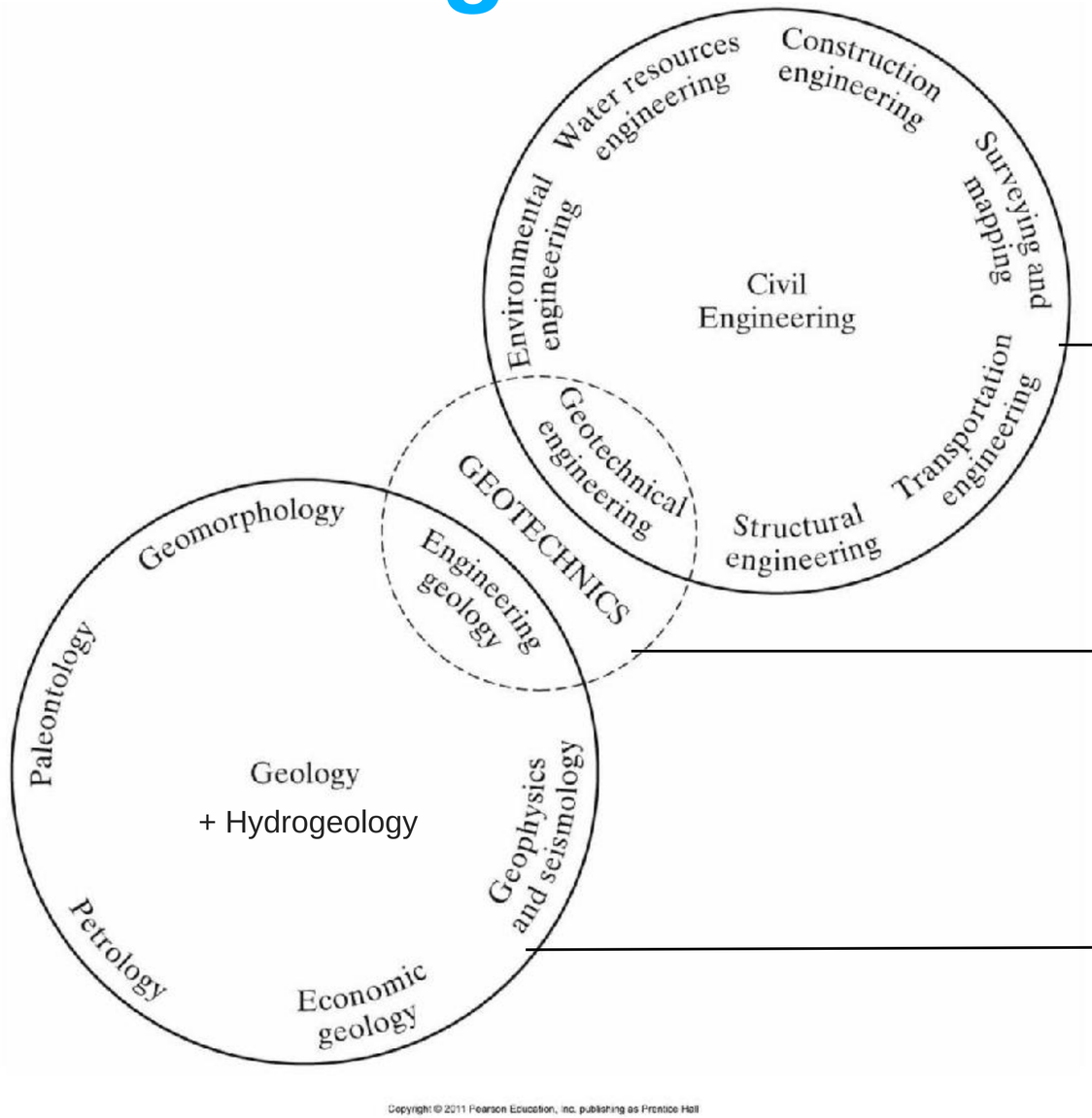
What is the Geotech Interoperability Experiment?

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



- An activity lead by the OGC Geoscience DWG (second IE after Borehole IE)
  - 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

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:

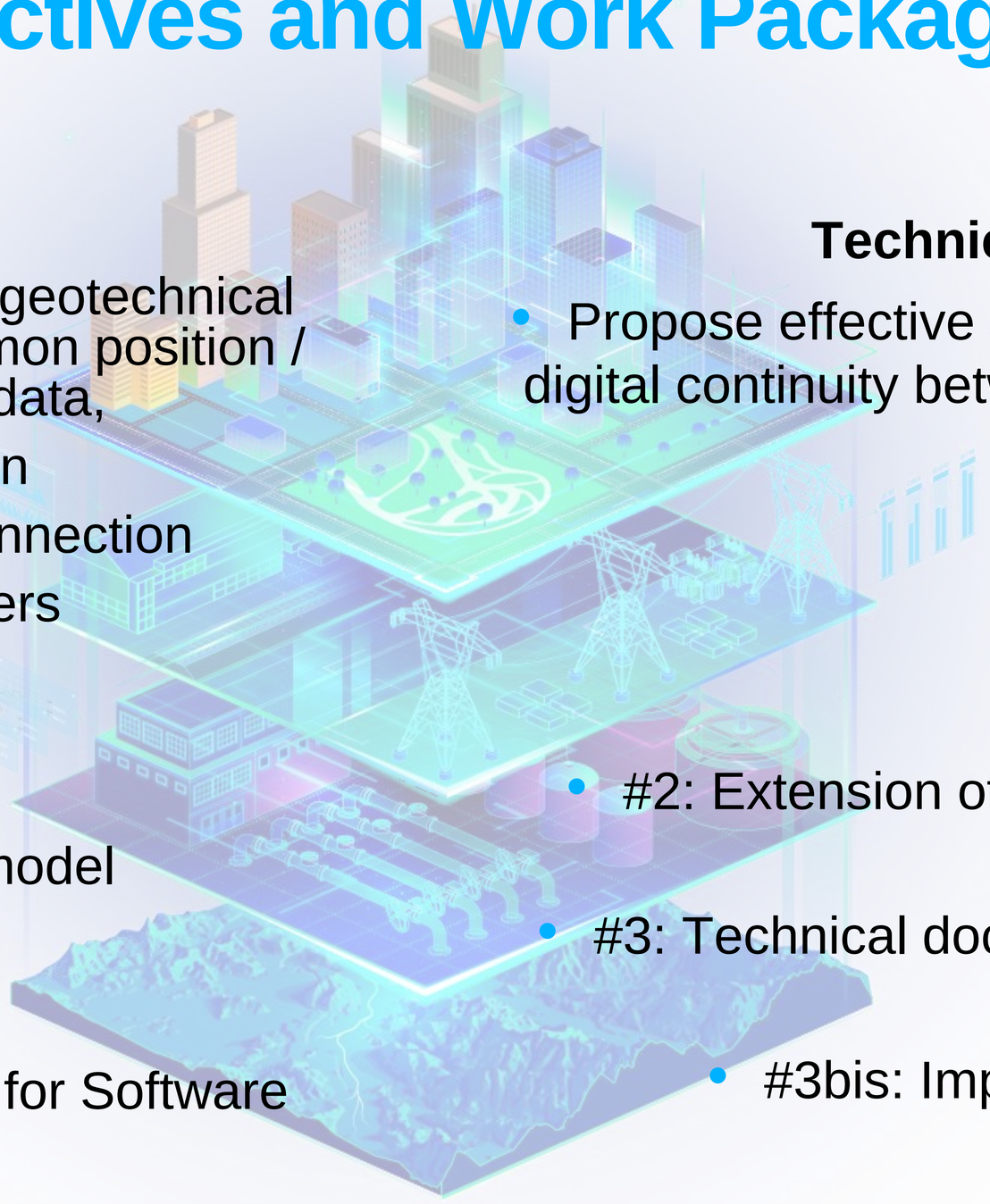
- #1: Common conceptual model
- #4a: White paper
- #4b: Technical paper
- #5: Implementation Guide for Software Vendors

Technical oriented goals

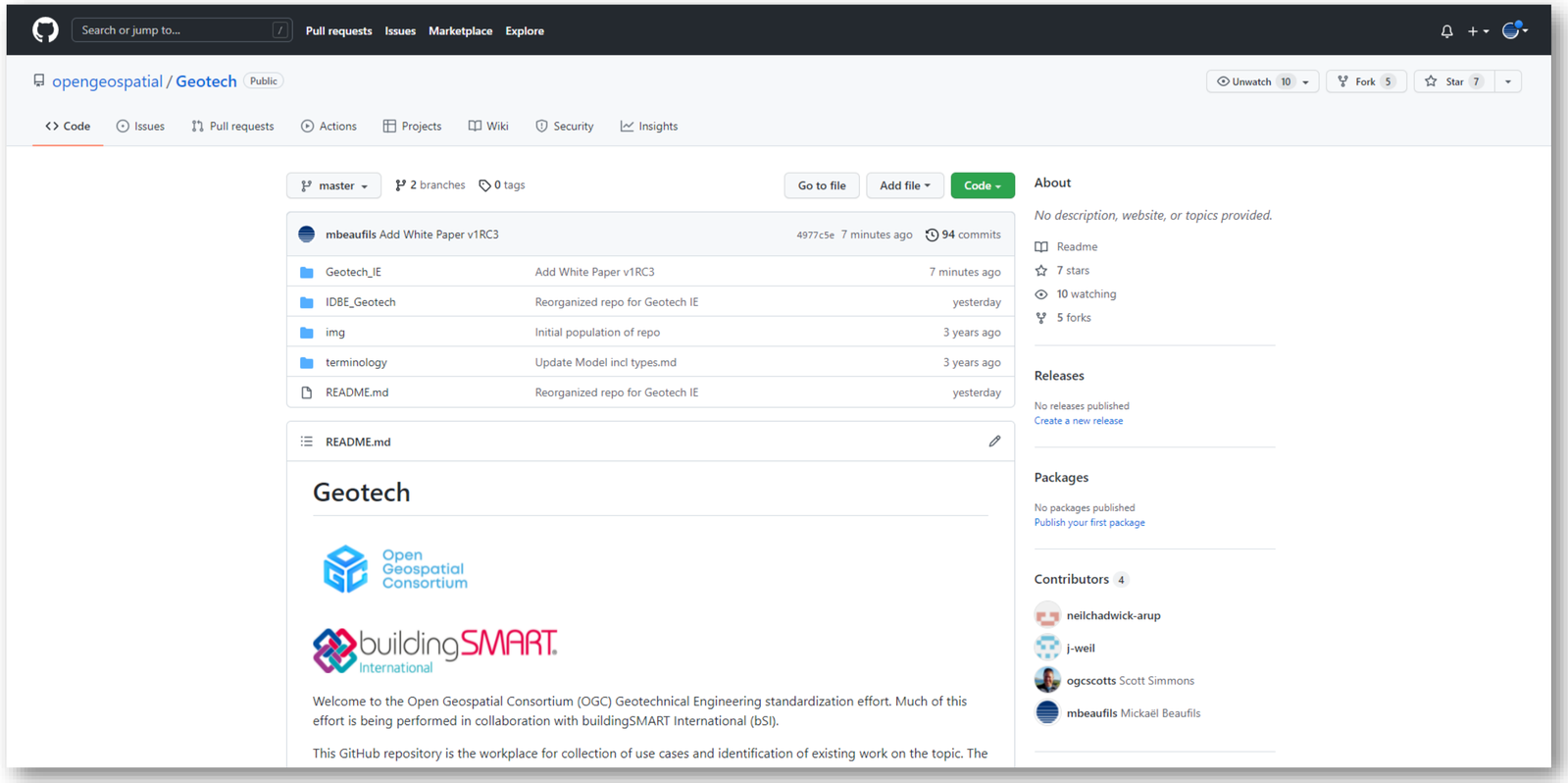
- Propose effective solutions to enable digital continuity between GIS and BIM

Work packages:

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

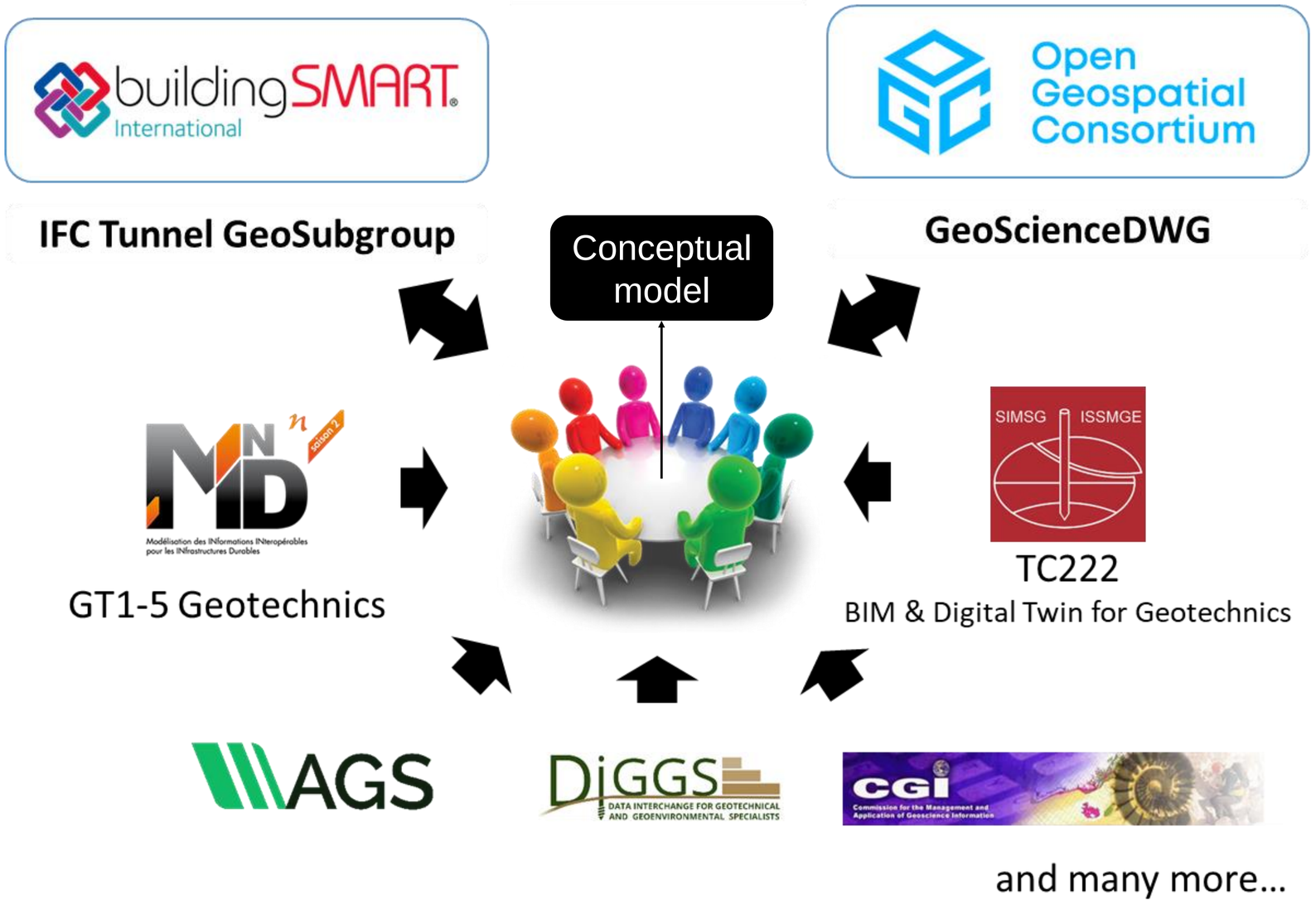


Work organization – “Workspace”



- Mail list: geotech.ie@lists.ogc.org
- GitHub: https://github.com/opengeospatial/Geotech
- Wiki: https://github.com/opengeospatial/Geotech/wiki

#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

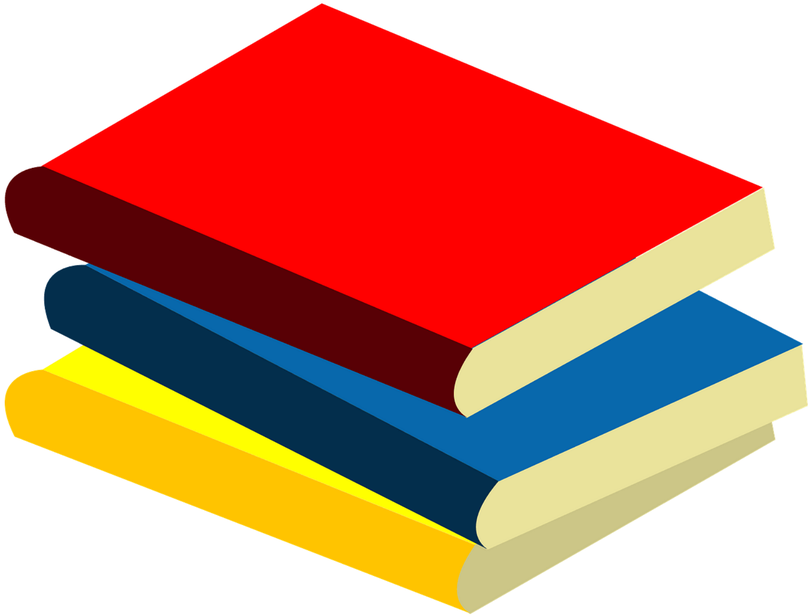
ENGEOL

ISRM

igs

#1: 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

#1: 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

#1: eg. Borehole page

- 1 page per concept
- Same structure
  - Definition
  - Realizations with OGC, bSI, AGS and DIGGS standards
  - FAQ

Borehole

Mickaël Beaufils edited this page on Jan 12 · 31 revisions

What is a Borehole?

A Borehole is the generalized term for any narrow shaft drilled in the ground, either vertically, horizontally, or inclined.

Realizations

Data model	Concept name	Defi
OGC GeoSciML	Borehole	A Borehole is the generalized term for any nar vertically, horizontally, or inclined.
IFC	Borehole	Same as OGC GeoSciML
AGS	LOCA	AGS LOCA includes exploratory holes of any ty
		A sampling feature feature that is a deep, narr

Properties

FAQ

What about Trial Pit?

Despite a lot of similarities with borehole, the Trial Pit is proposed as a different concept.

See https://github.com/opengeospatial/Geotech/wiki/TrialPit for its description.

What about Borehole core?

A borehole core is considered as a MaterialSample.

See https://github.com/opengeospatial/Geotech/wiki/MaterialSample for its description.

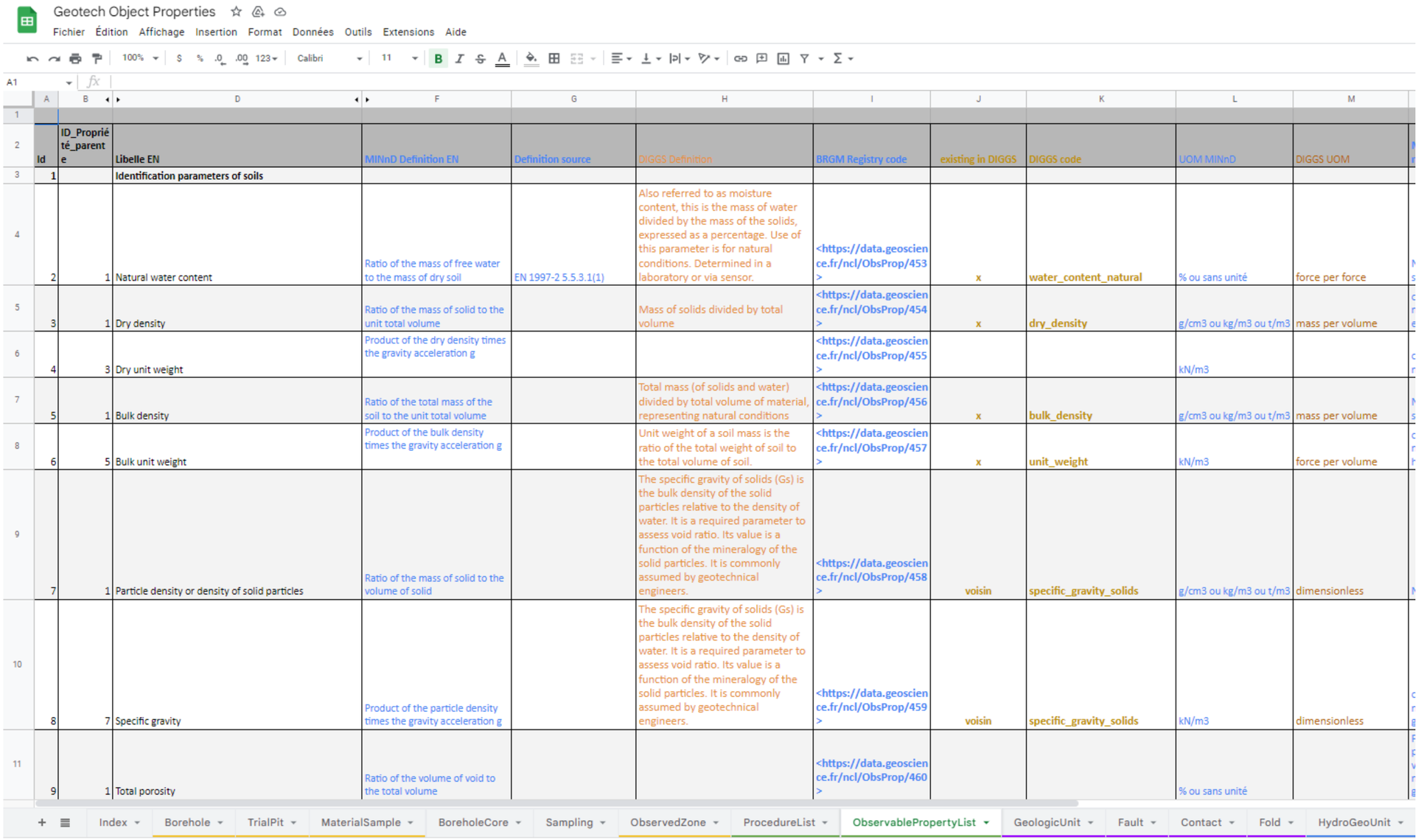
#1: Borehole properties

PropertyGroup	PropertyName	Cardinality	Definition	OGC (EPOS:Bor	IFCTunnel (Boreh	IFCTunnel Def	AGS	DIGGS
ObjectSpecificInfo	driller	0..1	driller reports the organisation responsible for drilling th	x	x		PROJ_CONT (see c	x
ObjectSpecificInfo	drillStartDate	0..1	drillStartDate reports the date of the start of drilling forn	x	x		LOCA_STAR	x
ObjectSpecificInfo	drillEndDate	0..1	drillEndData reports the date of the end of drilling forma	x	x		LOCA_ENDD	x
ObjectSpecificInfo	startPoint	0..1	startPoint indicates the position relative to the ground su	x			See AGS comments	x
ObjectSpecificInfo	boreholeMaterialCustodian	0..1	boreholeMaterialCustodian reports the organisation that	x			No	-
ObjectSpecificInfo	source	0..1	source describes details and citations to source materials	x			No	x
ObjectSpecificInfo	parentBorehole_identifier	0..1	parentBorehole_uri contains a URI referring to one or m	x			See AGS comments	-
ObjectSpecificInfo	metadata_uri	0..1	metadata_uri contains a URI referring to a metadata recc	x			See AGS comments	
ObjectSpecificInfo	genericSymbolizer	0..1	genericSymbolizer contains an identifier for a symbol fr	x			No	?
ObjectSpecificInfo	cored	0..1	cored indicates if a core sample has been retrieved from	x			CORE group	x
ObjectSpecificInfo	associatedCoreIdentifier	0..1	associatedCoreIdentifier indicates the identifier of the co	x			CORE group	-
ObjectSpecificInfo	accessToPhysicalDrillCore	0..1	accessToPhysicalDrillCore indicates whether access to p	x			No	-
ObjectSpecificInfo	detailedDescription	0..1	the property detailedDescription is an association that lir	x			See AGS comments	-
				x			HORN group	-
					x		HORN group	x

- Same as for the concepts
  - Have a name + definition (either one existing or made for the project)
  - Define realizations with the different standards

Semantics alignment

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



Geotech Object Properties

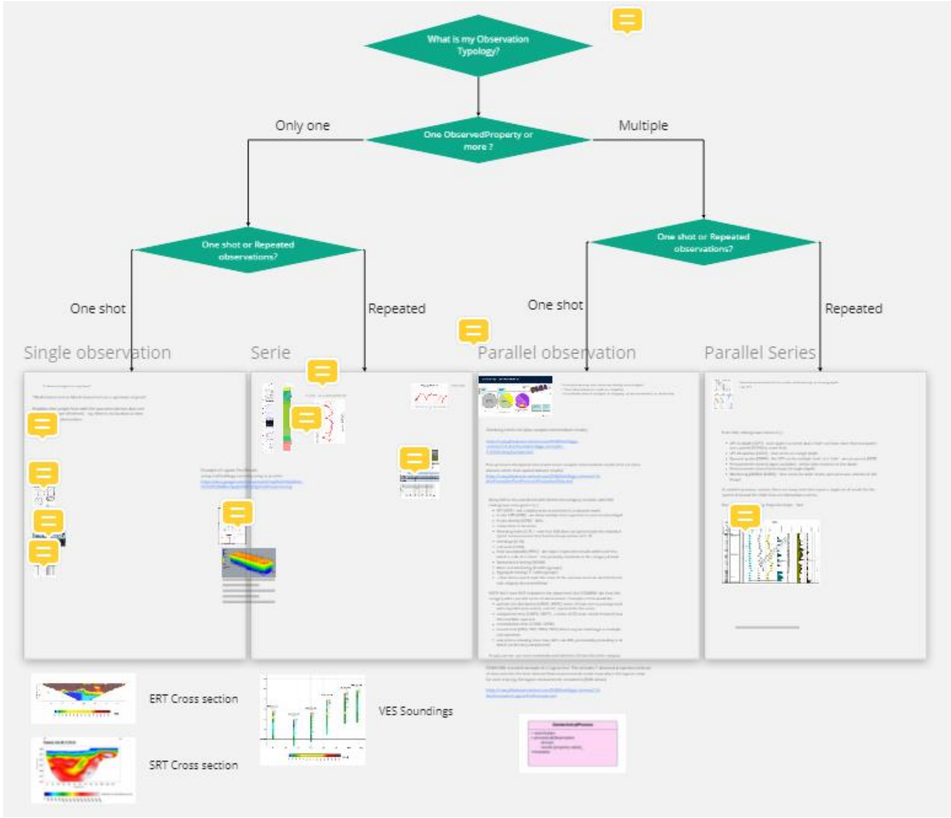
Fichier Édition Affichage Insertion Format Données Outils Extensions Aide

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	

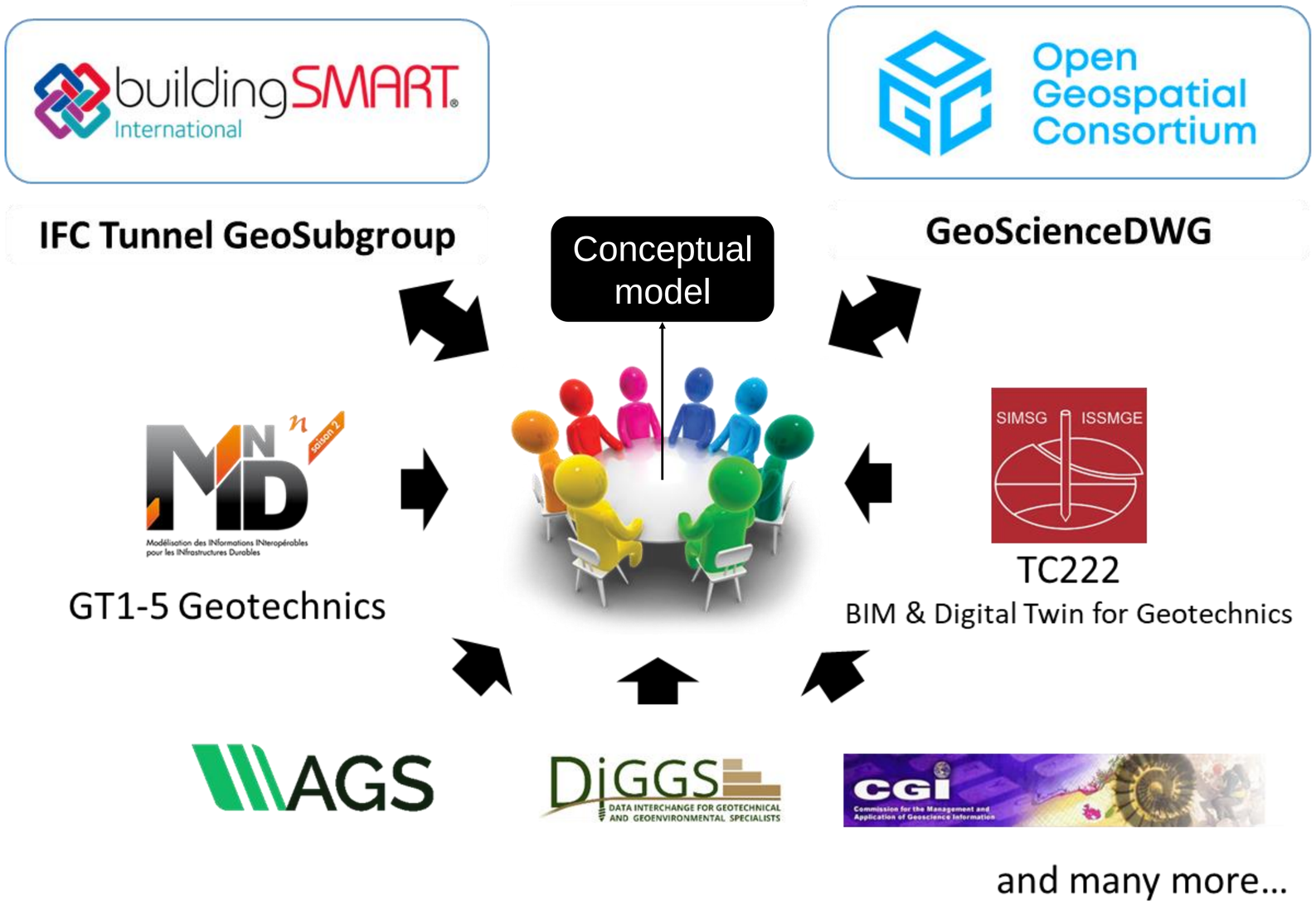
Index | Borehole | TrialPit | MaterialSample | BoreholeCore | Sampling | ObservedZone | ProcedureList | ObservablePropertyList | GeologicUnit | Fault | Contact | Fold | HydroGeoUnit

#1: Top discussions

- Observation with a complex result vs a collection of observations
- Observation vs Measurement
- Observation/Measurement vs Interpretation
- Observations nested in the procedure vs Observations and associated procedures
- Sample vs Specimen



#1: Conceptual model governance?



#2: OGC standards extensions

- New concepts to be proposed:
  - GeotechnicalUnit
  - DiscreteDiscontinuity

- Existing concepts that will be proposed properties for geotechnics: including GeologicUnit, ShearDisplacementStructure, Contact, Fold, HydroGeoUnit, FluidBody, FluidBodySurface.
  - Aligned with the IFC Tunnel 4.4 candidate

- Concepts that might worth being revisited: GeoSciMLBorehole
  - Cf. BoreholeIE conclusion suggesting to have a Borehole SWG
  - Interesting similarities between the DIGGS borehole concept and the solution envisaged by BoreholeIE (see Kathi’s presentation)

#3: OGC APIs for Geotech

- Main interest for geotechnics is (but is not limited to):
  - Features
  - Observations & Measurements

- OGC APIs for consideration (non-exhautive)
  - OGC API Feature
  - OGC SensorThingsAPI

#3: OGC APIs for Geotech - Implementation

- Known implementations based on
  - Borehole description – WFS
  - Borehole data (Geology logs) – SOS
  - GeologicUnit – WFS
  - ShearDisplacementStructure (faults) – WFS
  - Borehole data – OGC API Feature* (not based on a standard semantic)

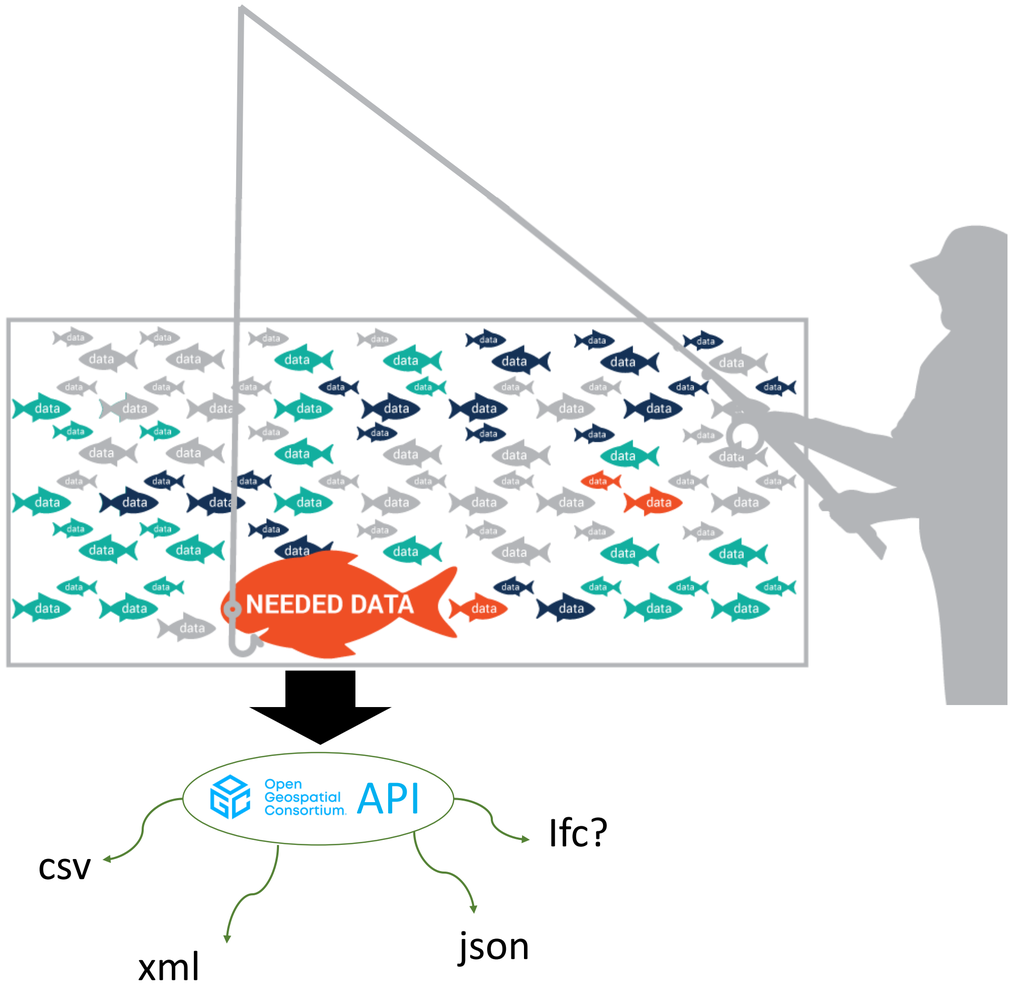
- Current implementations on development
  - Borehole data – SensorThingsAPI > See Kathi’s presentation

#3: OGC APIs for Geotech – usage

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

Served with: OGC API Feature OGC SensorThingsAPI

#3: OGC APIs for Geotech



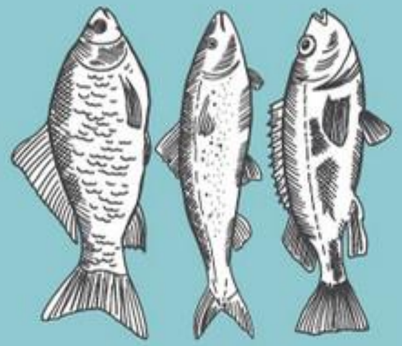
- Intention
  - Be able to discover existing data
  - Be able to get / download them
- Requirement
  - Meta description of data
  - Appropriate data formats for usages
  - Shared data!
- Proposed solution
  - Data discovery: Catalogs + search functionnality
  - Data accessibility: OGC APIs

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*

#3: OGC APIs for Geotech - Documentation

- Already existing material
  - API for INSPIRE
    - Studying the fitness of OGC API Features and SensorThings API as an INSPIRE Download service
  - To be extended with geotech examples

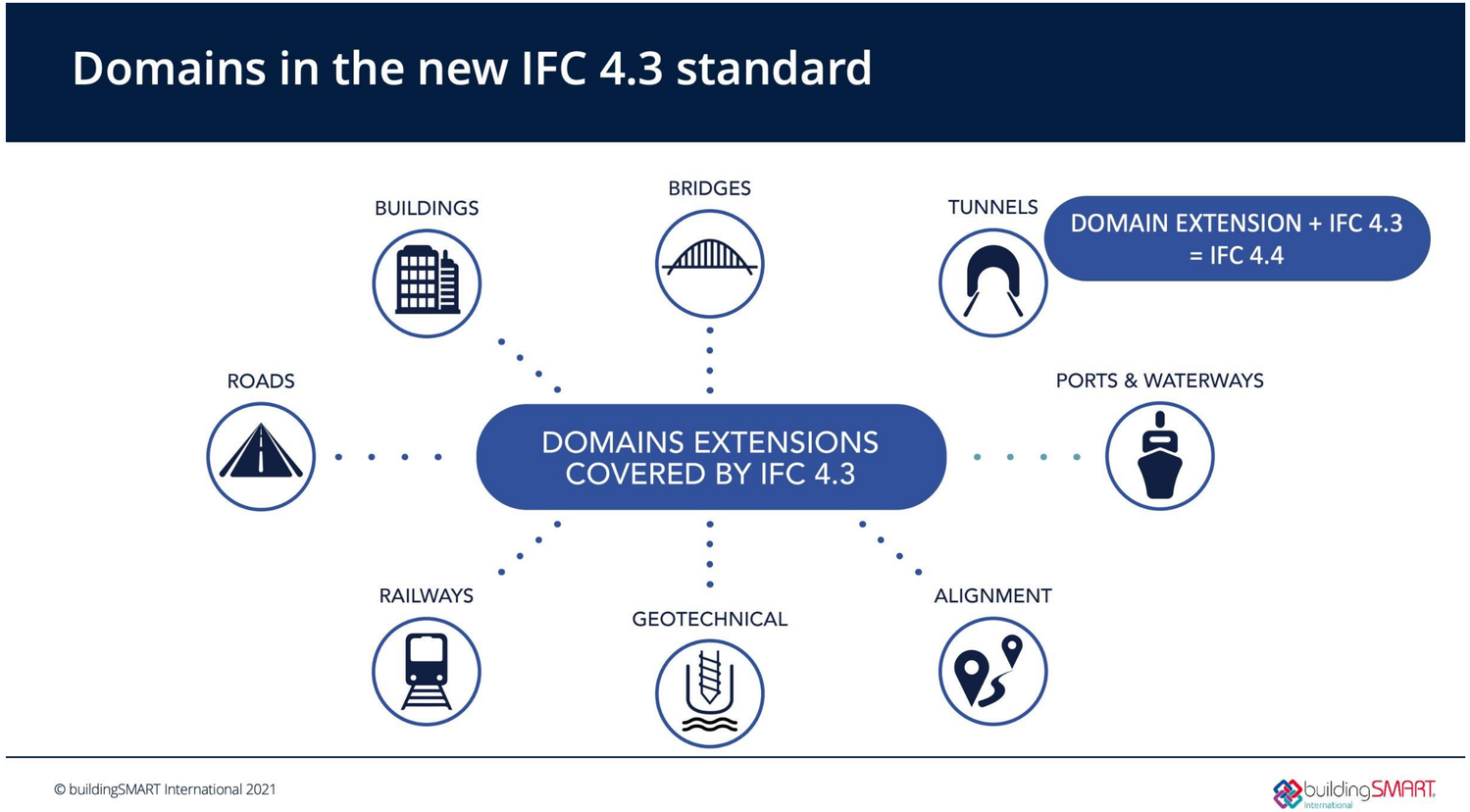
https://joinup.ec.europa.eu/collection/elise-european-location-interoperability-solutions-e-government/api-inspire

#3: bSI Implementation forum

- Launched in January 2023

- Proposing to test the IFC 4.4 candidate standards that includes geotechnics

- Several big players of AEC already engaged but also new solution providers



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

#4a: White paper (starting Geotech IE)

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

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

Neil Chadwick, AGS Data Management Working group

Dan Ponti, DIGGS Steering Comitee

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, Antea Group, Geotechnical Engineer

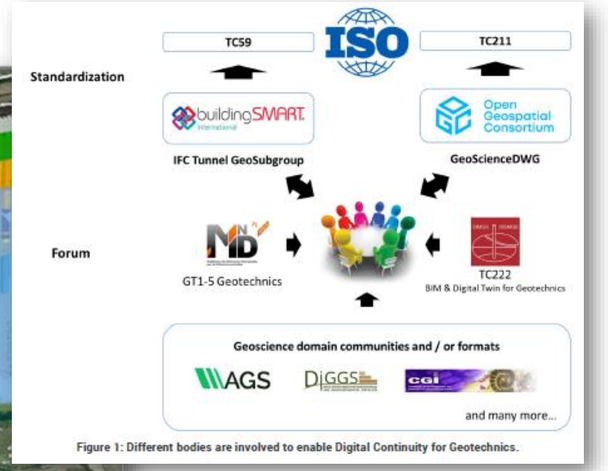


Figure 1: Different bodies are involved to enable Digital Continuity for Geotechnics.

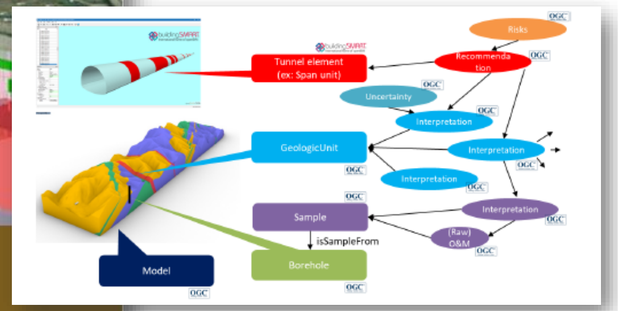
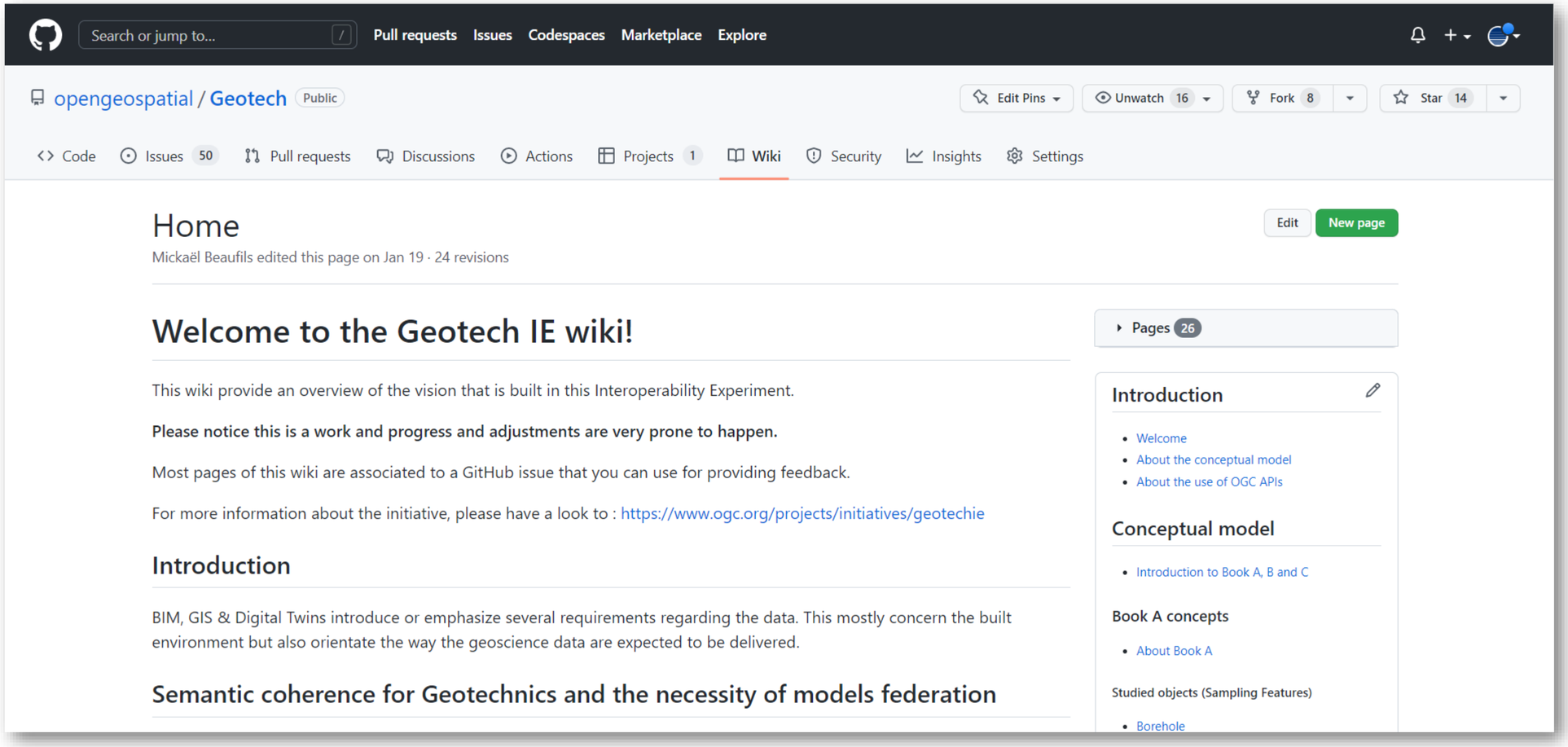


Figure 6: Clay in English / Argile in French / Ton in German: beside the language, several definitions exist. Reference to registries, thesaurus or data dictionaries enable to clarify the one that is used by the data provider.

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

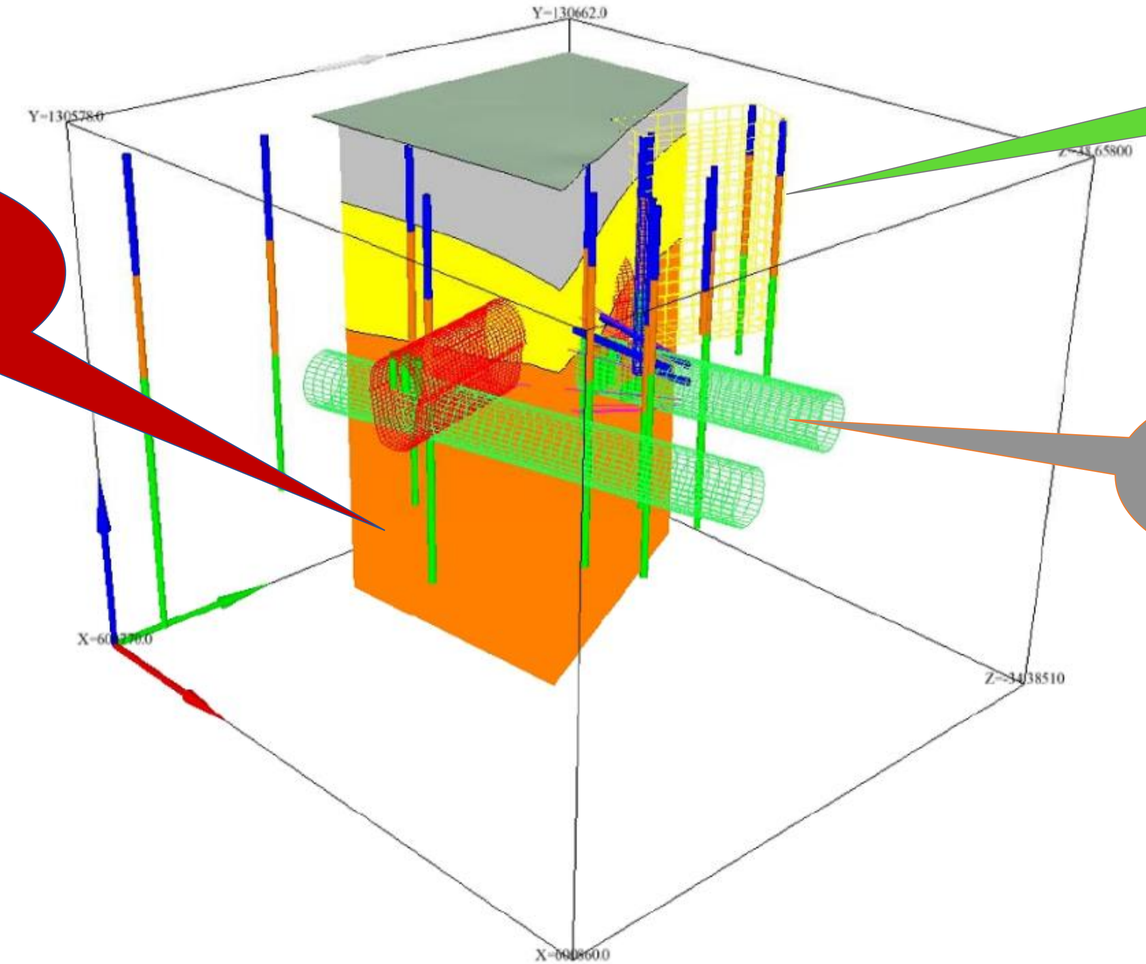
#4b: Technical paper (closing Geotech IE)

- Will mostly be an index of the production of the group



#5: Implementation guide for software vendors

- Not yet started
- Geotech IE report plan for the next bSI Summit (Roma, March ‘23)



Borehole

Borehole type
Diameter
Lithologic description
TCR, RQD, MWD…

Geotechnical Unit

Lithologic description
Geotechnical properties
Permeability
Geochemical properties
…

Structural object

Object type
Material (concrete, steel…)
Strength
…

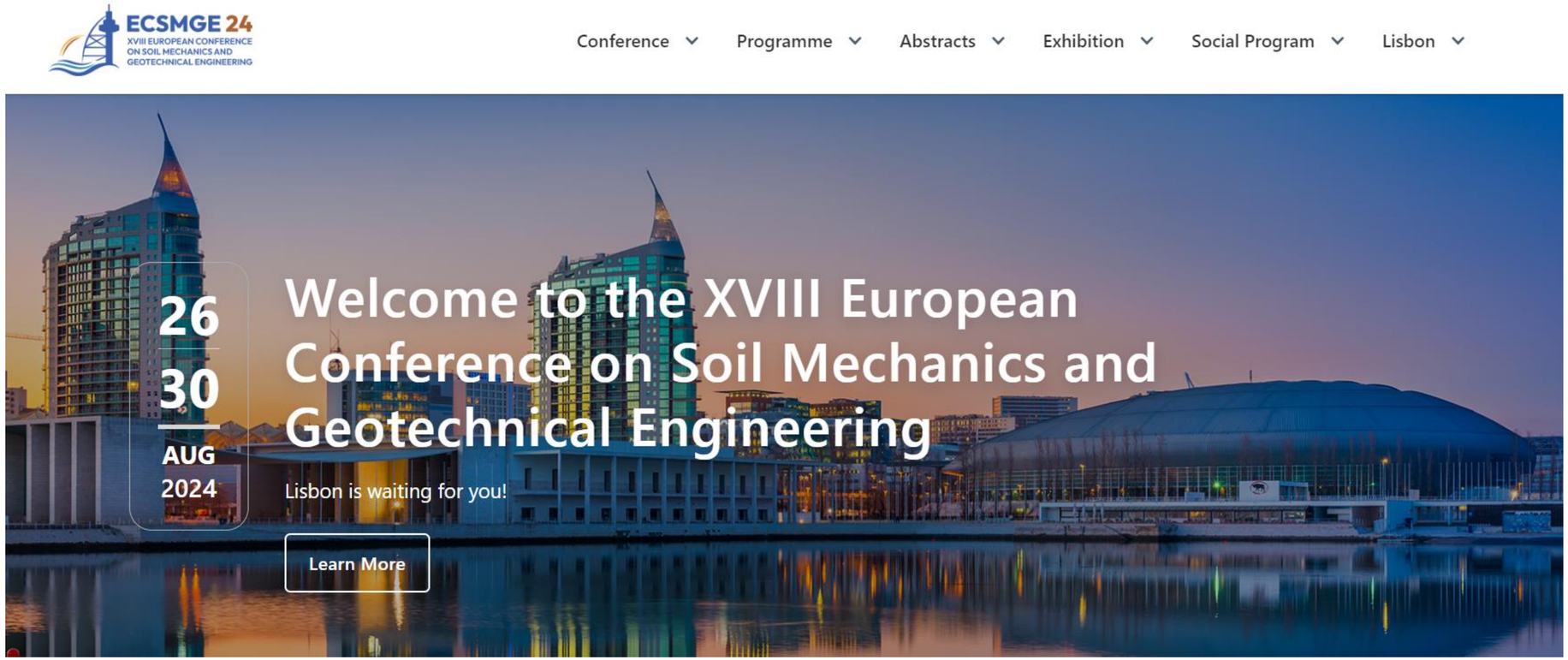
Observation

Interpretation

Observation

Feature

News from ISSMGE TC222



- Discussion to have a workshop dedicated to BIM and Digital Twins for Geotech

Questions?

Contact: m.beaufils@brgm.fr