Data Space & Digital Twins toward Climate-Resilient Infrastructures

The proposals from MINnD

MINnD saison 2

Modélisation des INformations INteropérables pour les INfrastructures Durables

MINISTÈRE DE LA TRANSITION ÉCOLOGIQUE
Liberté Égalité Fraternité

GEO BIM
THEME: DIGITAL TRANSFORMATION OF CITIES AND THE BUILT ENVIRONMENT
4-5 MAY 2023, ROTTERDAM, THE NETHERLANDS

IREX
Institut pour la recherche appliquée et l'expérimentation en génie civil

Speakers

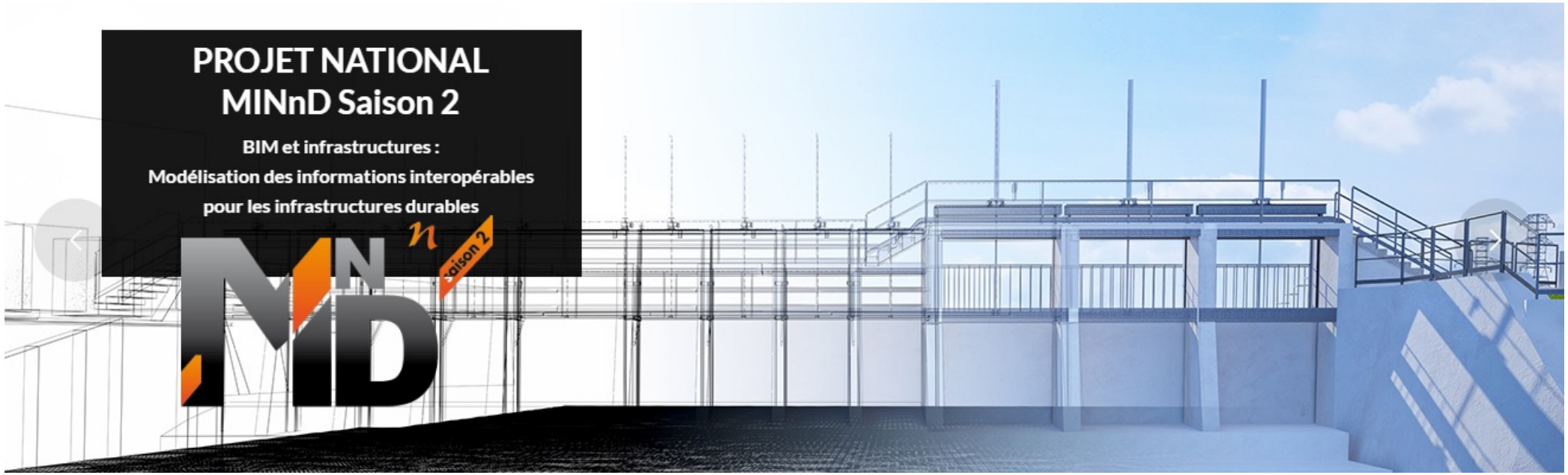
- François Robida
- Vincent Keller
- Christophe Castaing

Agenda

1. Successes of MINnD season 2
2. MINnD's positions
3. Next steps towards a data space for construction

MINnD / A UNIQUE FRENCH « NATIONAL PROJECT »

- BIM for infrastructures
- Launched in 2014, closing its second season NOW



MINnD season 2

62 Partners representative of the construction ecosystem

How to define a process & data strategy at a territory scale ?

- Owners
- Engineering
- Contractors
- Laboratories
- Federations
- Software vendors
- Experts & Consultants
- Universities

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MINnD SEASON 2 – WORKING GROUPS

Observatory / Project Mgmt

- WG0.1 - Development
- WG0.3 – Competences
- WG0.5 – Carbon impact

Data Structuring

- WG1.1 - IFC Bridge
- WG1.2 - IFC Rail
- WG1.3 - IFC Road
- WG1.4 - IFC Tunnel
- WG1.5 - IFC Geotechnic
- WG1.6 - IFC Earthworks
- WG1.7 - BIM & Archiving

Data Qualifying

- WG2.1 - Hand over modality
- WG2.2 - Uncertainties and tolerances management

Numerous (big) deliverables to be released by May 12th

Data Generation

- WG3.1 - PLM Integration during operation phase
- WG3.2 - Continuity BIM and Digital twin
- WG3.3 - Data management in collaboration mode

Data Collecting

- WG4.1 - Smart cities & IoT
- WG4.2 - Continuity of territory BIM-GIS

Data Using

- WG5.1 - Data Modeling (retro-engineering)

CDE - Collaboration

- WG6.2 - Collaboration platform & Platform collaboration
- WG6.3 - Project review

1. Targeting social & environmental & economical benefits at a territory scale
2. The strategy for digital twins and collaborative platforms in an open Common data environment
3. The crucial role of the owners
4. Digital continuity between BIM & GIS
5. The Implementation of IFC 4.3 & IFC4.4 is a crucial step forward
6. Carbon footprint of digital in construction

WHAT'S NEXT ?

- We have built a community that has worked in collaborative mode... and wishes to continue
- Much remains to be done to implement all that has been produced
- But we must also address the new challenges (climate, energy, cricular economy, etc.)
- Going from the scale of the building or the infrastructure to that of the city

- From a technical point of view
  - Implement an interoperable collaborative platform model
  - Implement data space for construction (EU strategy – GAIA-X)
  - By developing digital commons

- Extend the partnership
  - At the national level by mobilizing more widely the local authorities
  - At European level by developing initiatives and partnerships
  - And by continuing to bring the worlds of BIM and GIS closer together

MINnD's positions

Vincent KELLER,

Egis, Head of Digital Engineering Department

MINnD co-Leader

egis

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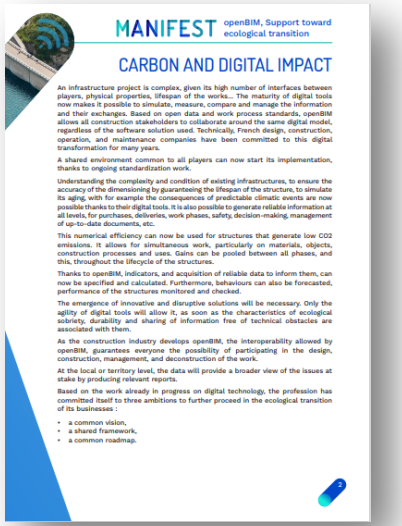
①Targeting social & environmental & economical benefits at a territory scale

MANIFEST « OPEN BIM, SUPPORT TOWARD THE ECOLOGICAL TRANSITION »

- **Ambition 1 : A COMMON VISION**
- **Ambition 2 : A SHARED FRAMEWORK**
- **Ambition 3 : A COMMON ROADMAP**


MANIFEST openBIM, Support toward ecological transition

CARBON AND DIGITAL IMPACT

An infrastructure project is complex, given its high number of interfaces between players, physical properties, lifespan of the works... The maturity of digital tools now makes it possible to simulate, measure, compare and manage the information and their exchanges. Based on open data and work process standards, openBIM allows all construction stakeholders to collaborate around the same digital model, regardless of the software solution used. Technically, French design, construction, operation, and maintenance companies have been committed to this digital transformation for many years.

A shared environment common to all players can now start its implementation, thanks to ongoing standardization work.

Understanding the complexity and condition of existing infrastructures, to ensure the accuracy of the dimensioning by guaranteeing the lifespan of the structure, to simulate its aging, with for example the consequences of predictable climatic events are now possible thanks to their digital tools. It is also possible to generate reliable information at all levels, for purchases, deliveries, work phases, safety, decision-making, management of up-to-date documents, etc.

This numerical efficiency can now be used for structures that generate low CO2 emissions. It allows for simultaneous work, particularly on materials, objects, construction processes and uses. Gains can be pooled between all phases, and this, throughout the lifecycle of the structures.

Thanks to openBIM, indicators, and acquisition of reliable data to inform them, can now be specified and calculated. Furthermore, behaviours can also be forecasted, performance of the structures monitored and checked.

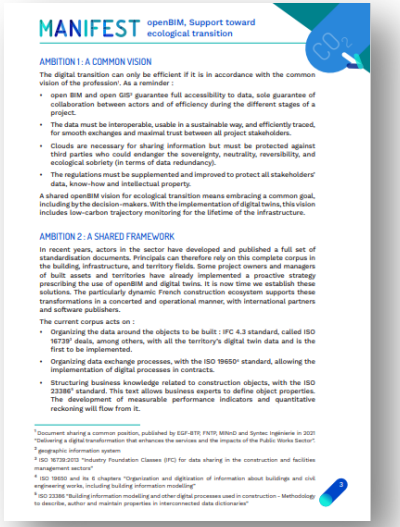
The emergence of innovative and disruptive solutions will be necessary. Only the agility of digital tools will allow it, as soon as the characteristics of ecological sobriety, durability and sharing of information free of technical obstacles are associated with them.

As the construction industry develops openBIM, the interoperability allowed by openBIM, guarantees everyone the possibility of participating in the design, construction, management, and deconstruction of the work.

At the local or territory level, the data will provide a broader view of the issues at stake by producing relevant reports.

Based on the work already in progress on digital technology, the profession has committed itself to three ambitions to further proceed in the ecological transition of its businesses :

- a common vision,
- a shared framework,
- a common roadmap.


MANIFEST openBIM, Support toward ecological transition

AMBITION 1 : A COMMON VISION

The digital transition can only be efficient if it is in accordance with the common vision of the profession[1]. As a reminder :

- open BIM and open GIS[2] guarantee full accessibility to data, sole guarantee of collaboration between actors and of efficiency during the different stages of a project.
- The data must be interoperable, usable in a sustainable way, and efficiently traced, for smooth exchanges and maximal trust between all project stakeholders.
- Clouds are necessary for sharing information but must be protected against third parties who could endanger the sovereignty, neutrality, reversibility, and ecological sobriety (in terms of data redundancy).
- The regulations must be supplemented and improved to protect all stakeholders' data, know-how and intellectual property.

A shared openBIM vision for ecological transition means embracing a common goal, including by the decision-makers. With the implementation of digital twins, this vision includes low-carbon trajectory monitoring for the lifetime of the infrastructure.

AMBITION 2 : A SHARED FRAMEWORK

In recent years, actors in the sector have developed and published a full set of standardisation documents. Principals can therefore rely on this complete corpus in the building, infrastructure, and territory fields. Some project owners and managers of built assets and territories have already implemented a proactive strategy prescribing the use of openBIM and digital twins. It is now time we establish these solutions. The particularly dynamic French construction ecosystem supports these transformations in a concerted and operational manner, with international partners and software publishers.

The current corpus acts on :

- Organizing the data around the objects to be built : IFC 4.3 standard, called ISO 16739[3] deals, among others, with all the territory's digital twin data and is the first to be implemented.
- Organizing data exchange processes, with the ISO 19650[4] standard, allowing the implementation of digital processes in contracts.
- Structuring business knowledge related to construction objects, with the ISO 23386[5] standard. This text allows business experts to define object properties. The development of measurable performance indicators and quantitative reckoning will flow from it.

[1] Document sharing a common position, published by EGF-BTP, FNTP, MINnD and Syntec Ingénierie in 2021 "Delivering a digital transformation that enhances the services and the impacts of the Public Works Sector".
[2] geographic information system
[3] ISO 16739:2013 "Industry Foundation Classes (IFC) for data sharing in the construction and facilities management sectors"
[4] ISO 19650 and its 6 chapters "Organization and digitization of information about buildings and civil engineering works, including building information modelling"
[5] ISO 23386 "Building information modelling and other digital processes used in construction – Methodology to describe, author and maintain properties in interconnected data dictionaries"

MANIFEST openBIM, Support toward ecological transition

AMBITION 3 : A COMMON ROADMAP

It is now high time for Public Procurement to fully play its role as a lever for ecological transition. All players must be motivated by it, to implement it through digital transformation*, during all phases of the development and life of the infrastructures. New frameworks and terms of reference to guide the call for tenders will be required, including for the operation/maintenance phases to best conduct and control the monitoring of the works. The terms of reference of the public calls for tenders (technical as well as administrative specifications) should :

- Include technical specifications oriented towards openBIM and "open Cloud" technologies.
- Include specifications promoting the creation of digital twins as long-lasting digital assets.
- Optimize investments (CAPEX) and operating expenses (OPEX), and therefore the asset management of infrastructures, thanks to the technology available.
- Integrate quantifiable, standardized, and transparent parameters for fair competition, while comparing bids.
- Integrate these indicators in rating systems for the purpose of promoting the best bidders in terms of carbon footprint and circular economy.

* COMMISSION STAFF WORKING DOCUMENT "Scenarios for a transition pathway for a resilient, greener and more digital construction ecosystem" English version or an version française

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② Open BIM & Open CDE

Data sharing strategy at a territory scale : digital twins and collaborative platforms

- The use of standardized data models to model physical assets
  as designed, as built or as maintained
  allows to generate valuable digital assets
  which can be massively used during their lifecycle
  by the numerous stakeholders & users
  with their preferred tools.

- Interoperability & data sustainability are key requirements from appointing parties to generate digital twins and to leverage them at a territory scale.

- That is the aim of the open BIM & specifically through the IFC model.

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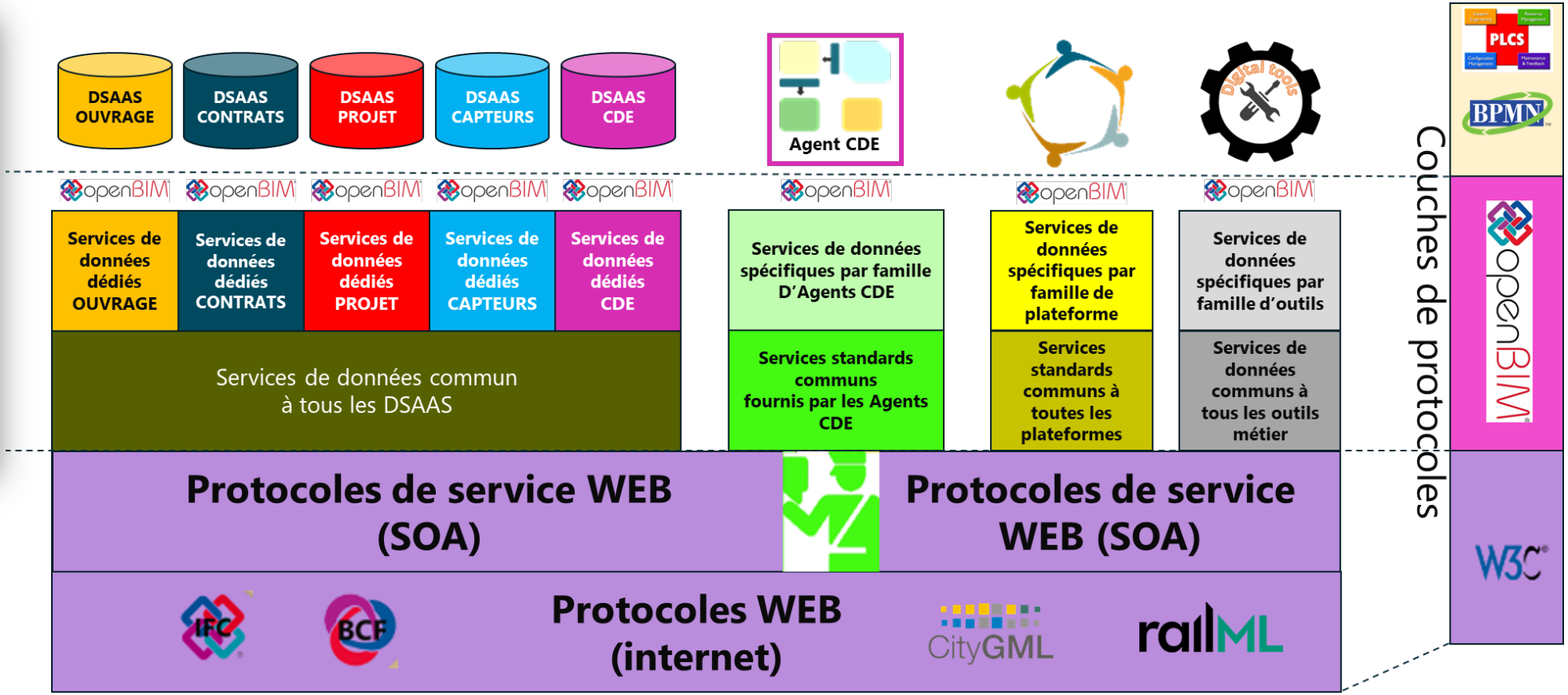
General architecture



OPEN CDE SPECIFICATIONS & ILLUSTRATOR

Livrable GT6.2

Plateformes collaboratives
et collaboration de plateformes
Spécifications pour un openCDE
et mise en œuvre d'un Illustrateur

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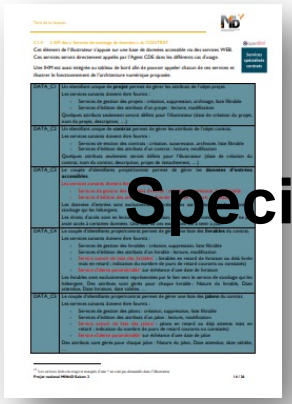
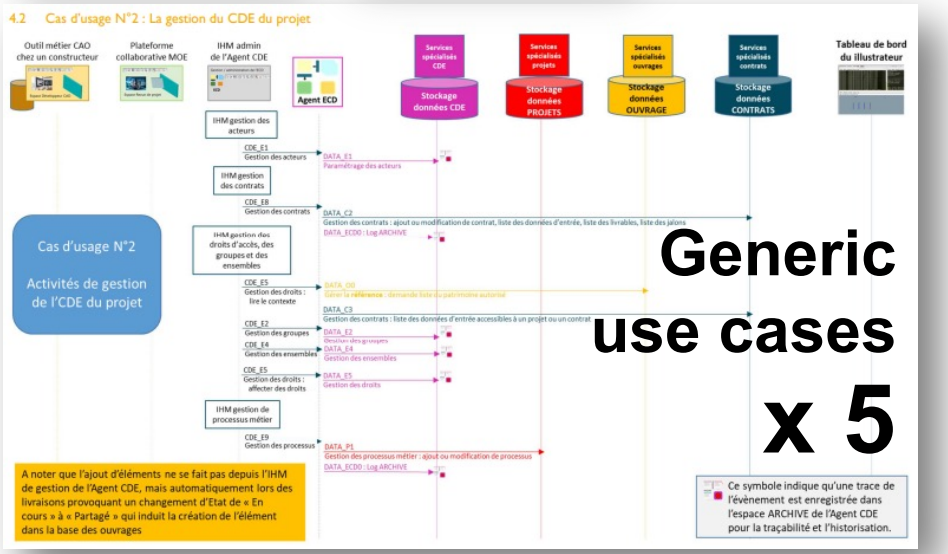
Thème de rattachement : Création des données

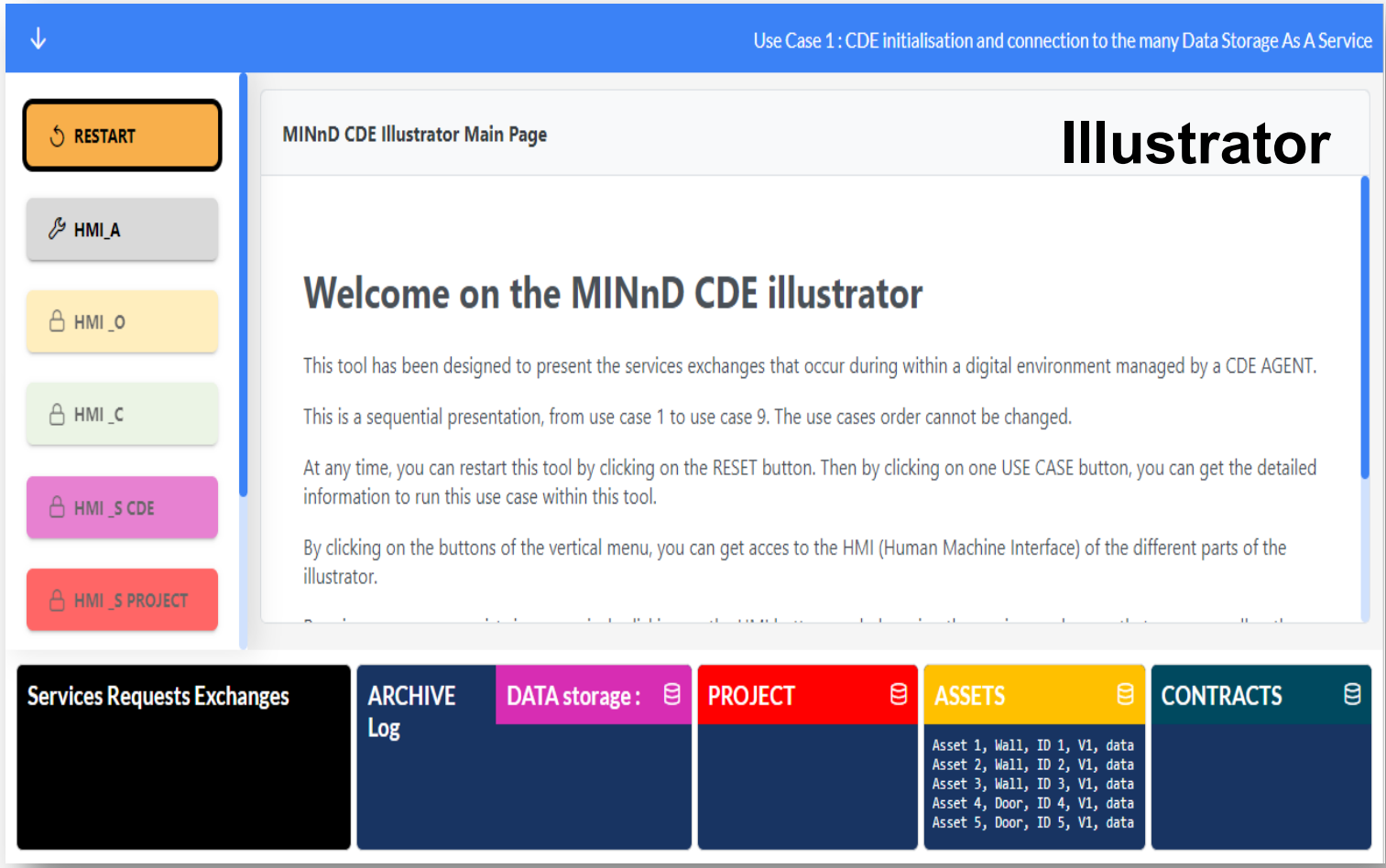


Specifications



Generic use cases x 5

https://egis-minnd-dev.k8s-lyon.ouidou.fr/restart



Illustrator

③The crucial role of the owners

The owners as appointing parties
have the power / responsibility to mandate / require,

- interoperable information
- for valuable usages.

The ecosystem actors as appointed parties
develop & provide the means to implement as required.

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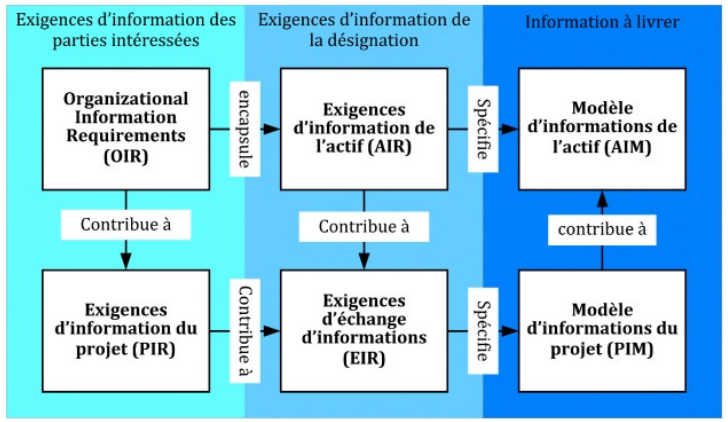
THE ISO19650 IS CENTRAL

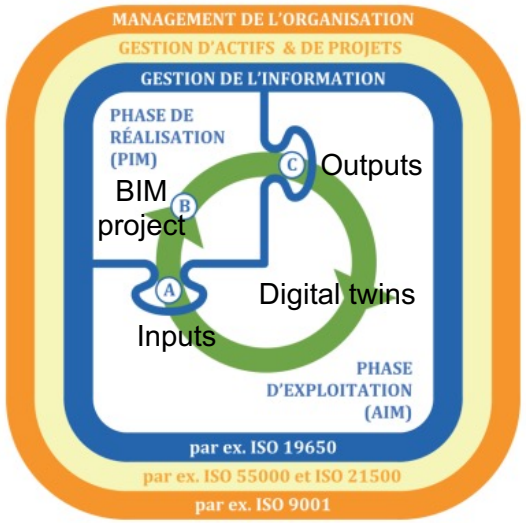
Information requirements (regulation or contractual)



NOTE Sur cette figure, « encapsule » signifie « fournit l'information à », « contribue à » signifie « fournit une information à », « spécifie » signifie « détermine le contenu, la structure et la méthodologie ».

Figure 2 — Hiérarchie des exigences d'information

Process



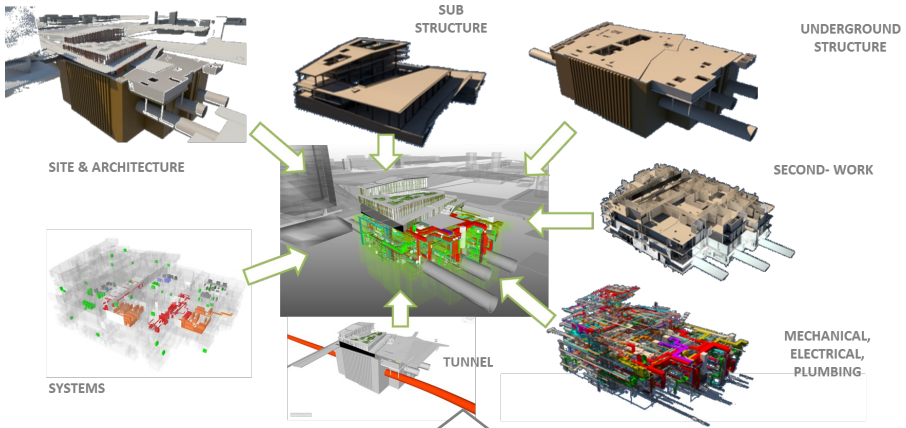
Légende

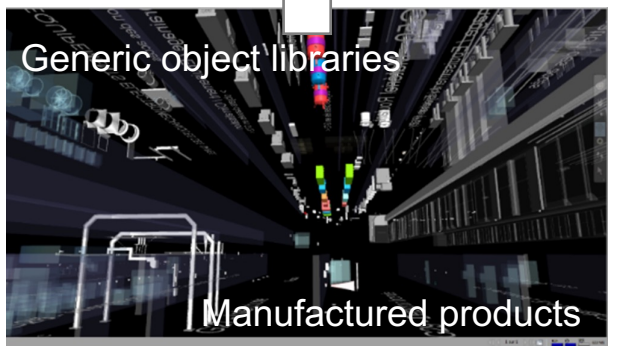
AIM	Modèle d'information de l'actif
PIM	Modèle d'information du projet
A	Début de la phase de réalisation – Transfert de l'information pertinente de l'AIM au PIM
B	Développement progressif du modèle de conception prévu dans le modèle de construction virtuelle
C	Fin de la phase de réalisation – Transfert de l'information pertinente au PIM à l'AIM

Figure 3 — Projet générique et cycle de vie de la gestion de l'information d'un actif

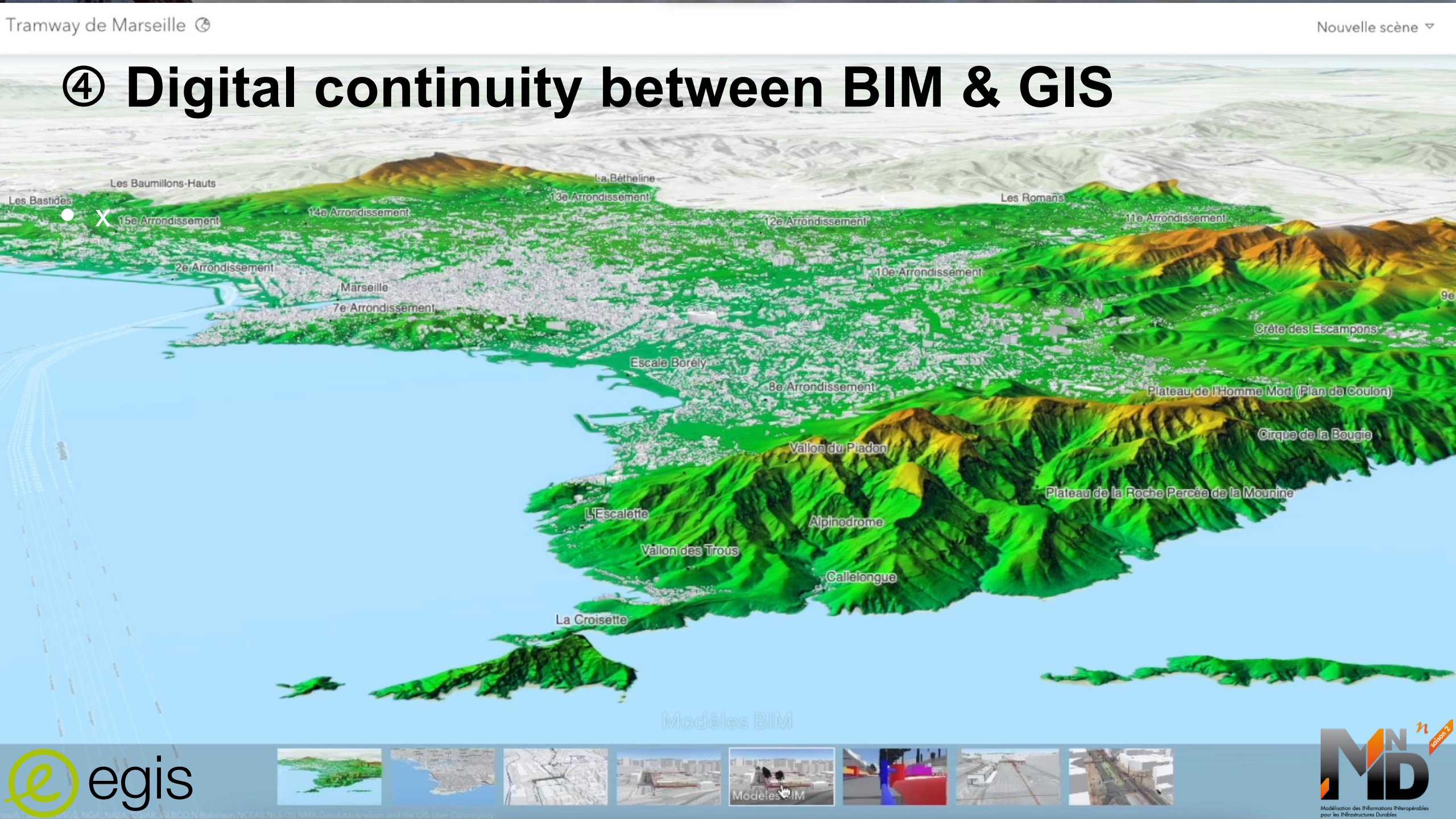
Deliverables > digital assets

Digital models





④ Digital continuity between BIM & GIS

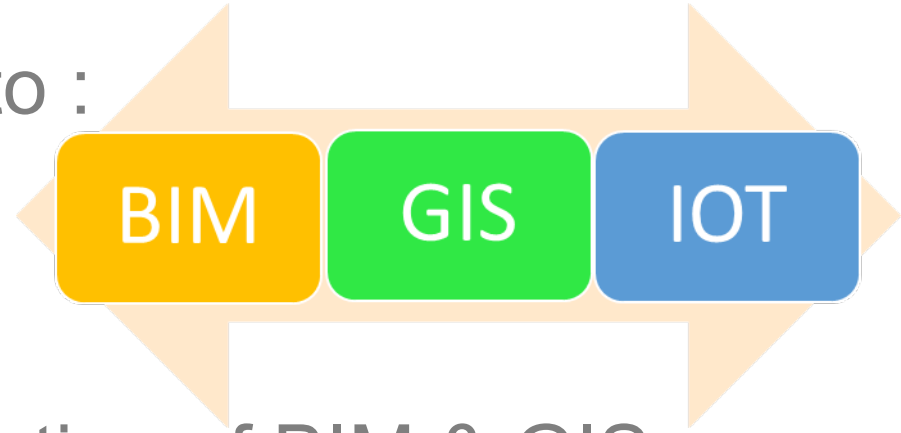


egis

Modélisation des INformations INteropérables pour les INfrastructures Durables

How to enhance the digital continuity between BIM & GIS ?

- Federate the BIM / GIS conceptual modeling approaches
- Federate the process of data sharing to :
  - Enhance the trust in the data
  - Enhance the useability of the data



- Develop services leveraging the federation of BIM & GIS databases
- Remove the (technological & human) barriers to change
- Complies with an open CDE architecture

⑤ The Implementation of IFC 4.3 & IFC4.4 is a crucial step forward

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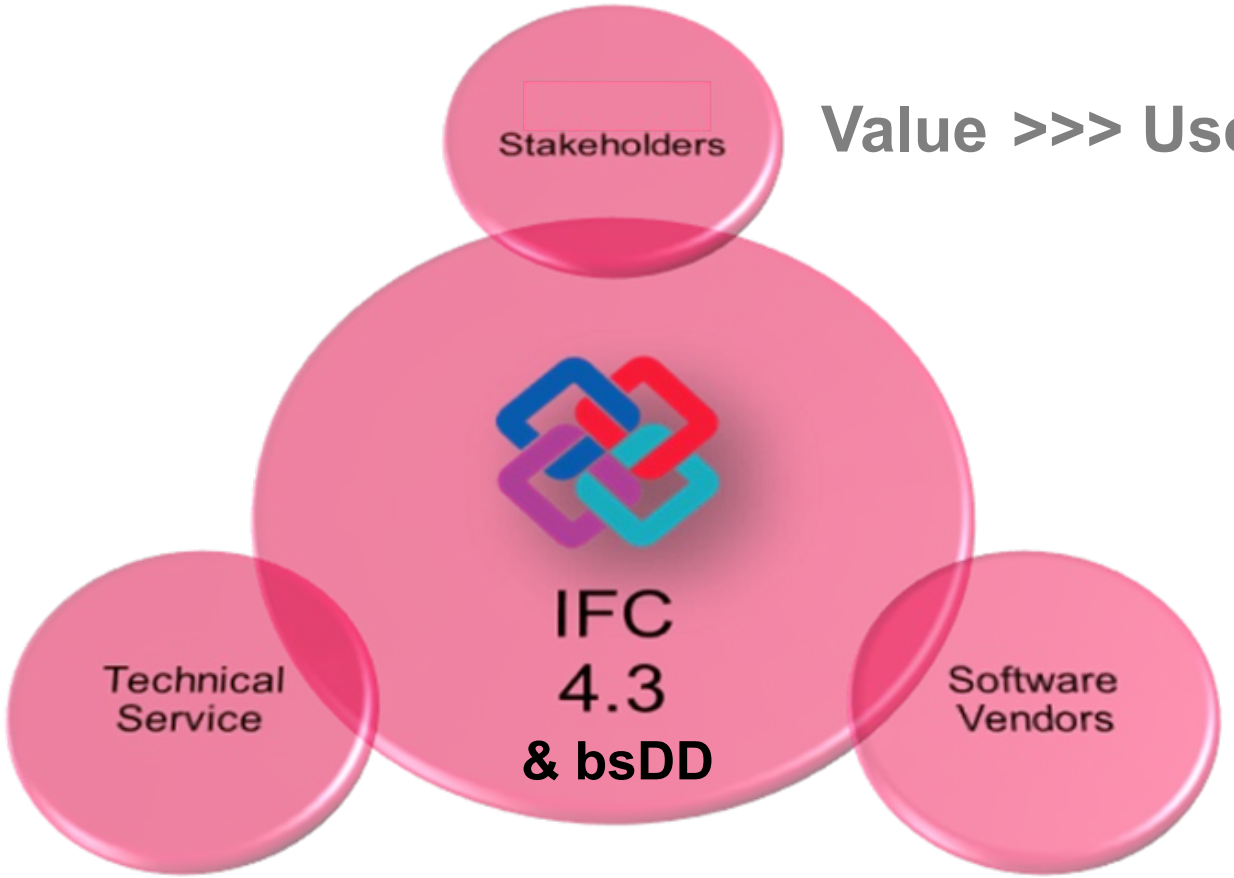
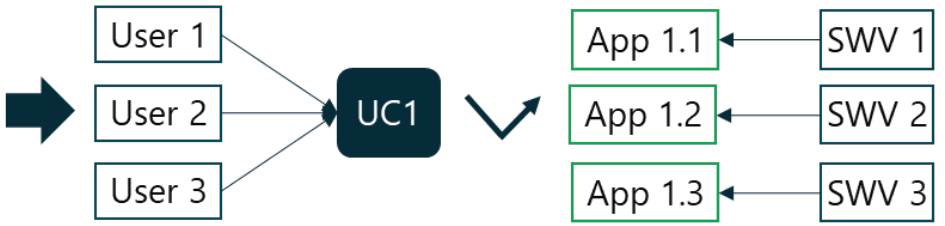
Collaborate on the Rules > a common Framework
Compete on the Game > enable the Services



IFC4.3 IMPLEMENTATION WORKFLOW

Leverage an Implementation platform to implement use cases (UC) > IDM/MVD/IDS

PAIN
1 use case (UC1)
is
not correctly specified
by appointing parties
and
not correctly supported
by existing tools
and
cannot be managed in IFC



GAIN
1 use case (UC1)
is
commonly specified
by appointing parties
and
implemented
by **several** software vendors
in **several** tools
by using the **IFC4.3** model
& **data dictionaries**

[aIFC4Rail]
applying IFC 4.3 for rail

& train BIM/GIS/data managers & users !

[Wrap up] MINnD's positions

1. Targeting social & environmental & economical benefits at a territory scale
2. The strategy for digital twins and collaborative platforms : open BIM & open CDE
3. The crucial role of the owners
4. Digital continuity between BIM & GIS
5. The Implementation of IFC 4.3 & IFC4.4 is a crucial step forward
6. Data sufficiency

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