# ETSI GR OEU 035 V1.1.1 (2024-02)


# Operational energy Efficiency for Users (OEU); Data interoperability format with applications for connected buildings

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# Foreword

This Group Report (GR) has been produced by ETSI Industry Specification Group (ISG) Operational energy Efficiency for Users (OEU).

# Modal verbs terminology

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# Executive summary

The opendthX open format is designed to ensure interoperability between digital content and construction software, enabling all parties involved in a construction project to contribute to the BIM process (see Figure 1), in particular by:

- enabling access to any type of content through any type of application, regardless of the tools used;
- enriching objects for advanced collaborative construction;
- standardizing input data in construction software to avoid the GIGO effect (i.e. Garbage In → Garbage Out) (see Figure 3);

with the aim of creating a "CIQO ready" collaborative environment: "Collaboration In → Quality Out" (see Figure 2):

- optimizing data transfers through the use of the data-on-demand concept, and thus meeting the need for digital sobriety.

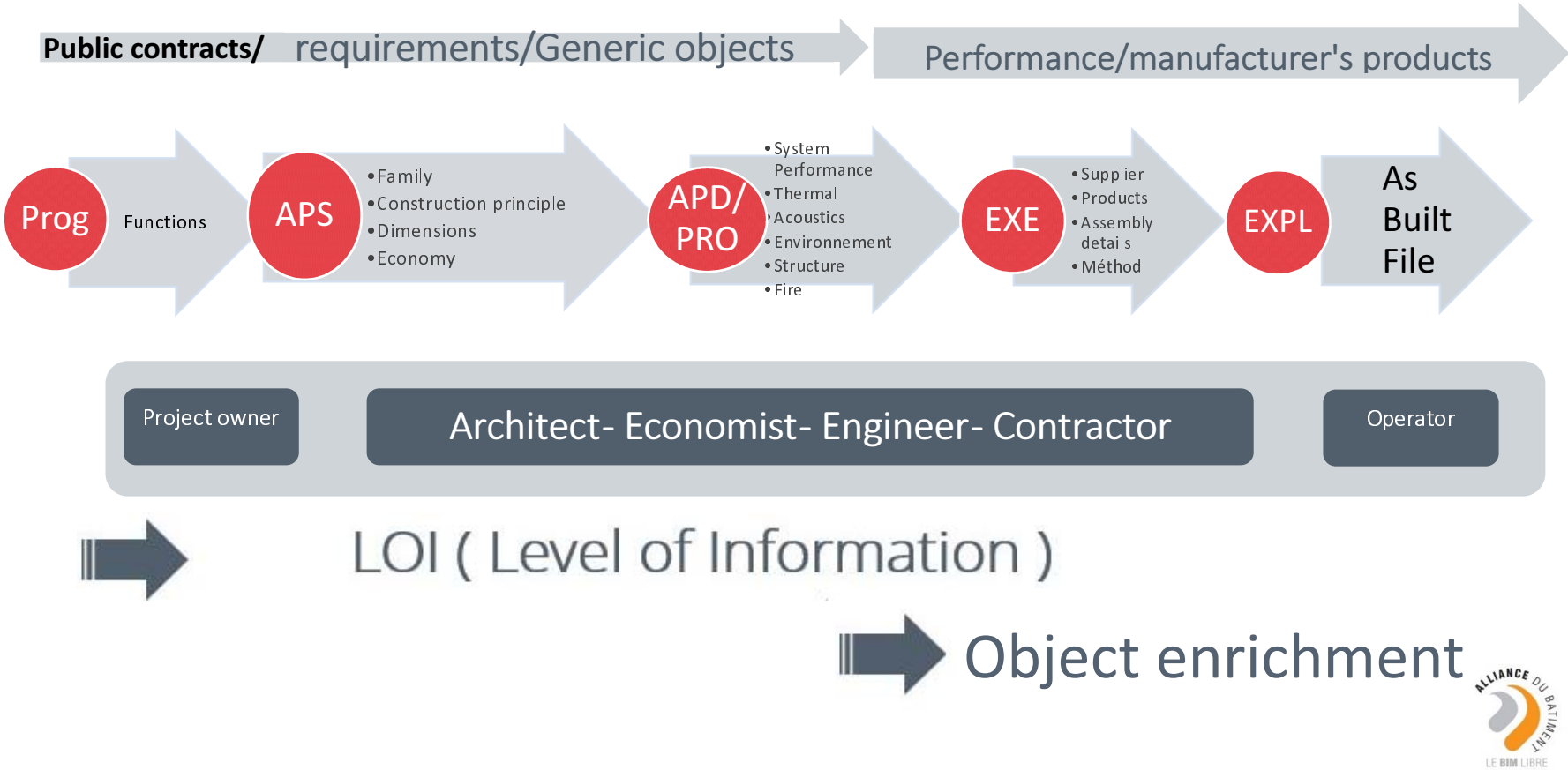
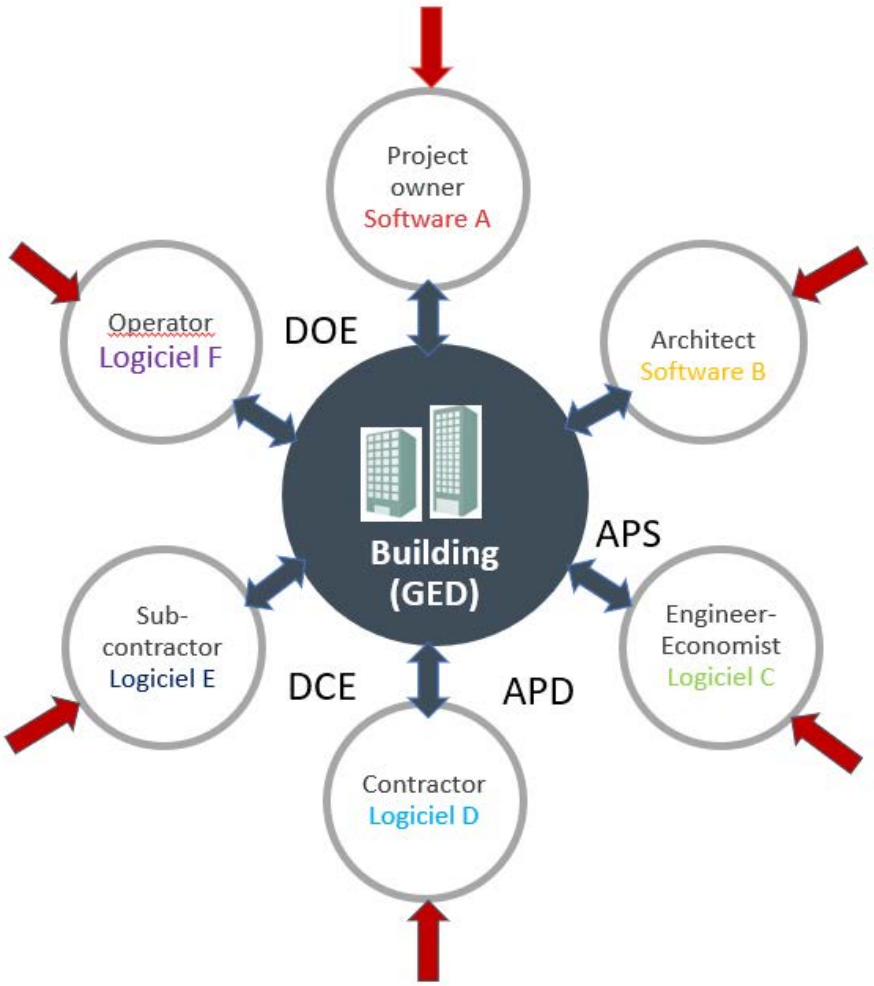
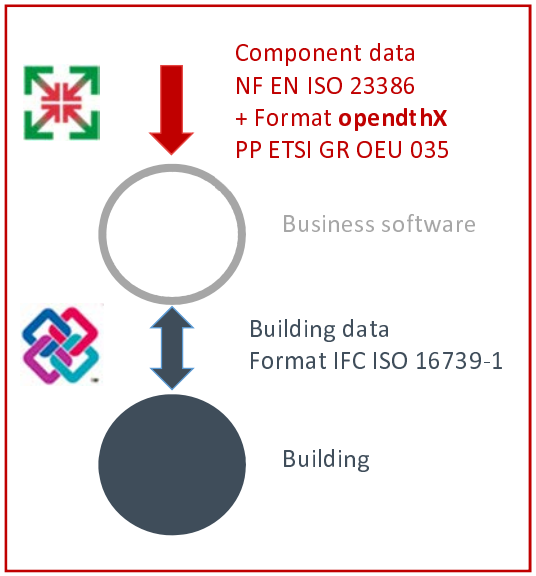

Public contracts/ requirements/Generic objects
Performance/manufacturer's products
Prog
Functions
APS
•Family
•Construction principle
•Dimensions
•Economy
APD/ PRO
•System Performance
•Thermal
•Acoustics
•Environnement
•Structure
•Fire
EXE
•Supplier
•Products
•Assembly details
•Méthod
EXPL
As Built File
Project owner
Architect- Economist- Engineer- Contractor
Operator
LOI ( Level of Information )
Object enrichment
ALLIANCE DU BATIMENT
LE BIM LIBRE

**Figure 1**

# OPEN DATA-CENTRISM = CIQO




CIQO = Collaboration In → Quality Out

**Figure 2**

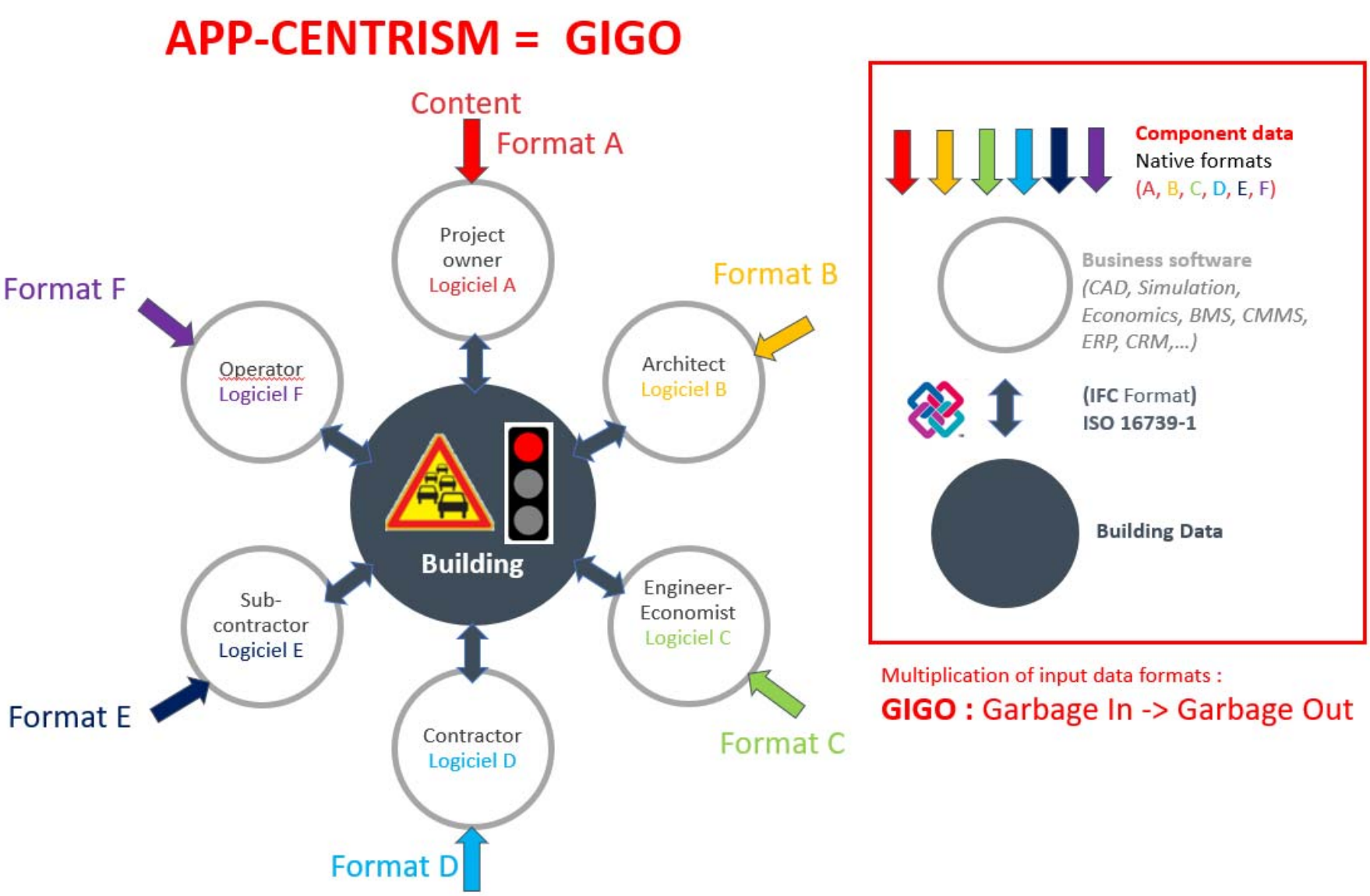

APP-CENTRISM = GIGO
Content
Format A
Project owner
Logiciel A
Format B
Architect
Logiciel B
Format F
Operator
Logiciel F
Building
Sub-contractor
Logiciel E
Engineer-Economist
Logiciel C
Format E
Format C
Contractor
Logiciel D
Format D
Component data
Native formats
(A, B, C, D, E, F)
Business software
(CAD, Simulation, Economics, BMS, CMMS, ERP, CRM,...)
(IFC Format)
ISO 16739-1
Building Data
Multiplication of input data formats :
GIGO : Garbage In -> Garbage Out

**Figure 3**

# 1 Scope

The present document deals with the opportunity of using the opendthX format to produce the digital twin applied to the operation of connected buildings.

# 2 References

## 2.1 Normative references

Normative references are not applicable in the present document.

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC.

[i.2] French decree n 2018-1075 of December 3, 2018, Article R2132-10.

NOTE: The buyer may require the use of tools electronic modelling of building data.
In this case, it offers means of access mentioned in Article R. 2132-14, until such time as these tools and devices have become commonly available to economic operators.

[i.3] In Belgian law: 17 Juin 2016 - Law on public contracts.

[i.4] Legal approach to interoperability: Interoperability is a user right according to Article L122-6-1 of the French Intellectual Property Code, version in force on November 26, 2021.

NOTE: Software is protected by copyright, except for interoperability.

[i.5] European data governance act 30/05/2022.

[i.6] Proposal for a European data directive (European data act) - 23/02/2022.

[i.7] Study report on the comparative cost of building a technical database of digital mock-up components. Virtual BIM Workshop project carried out as part of the French government's digital transition plan for the building industry. Version 2 of the document dated 11/04/2017.

NOTE: See Figures 4 and 5. Doc1_Etude2_ABV_BDD_20170411.pdf.

[i.8] Assessment of the costs of interoperability faults incurred by companies, clients and operators in the construction and operation of buildings. Rapport final de l'étude 08E86 commandée par la FFB (Fédération Française du Bâtiment). Authors: Michel Léglise and Bernard Ferriès, LAURENTI. December 2009.

NOTE: See Figures 4 and 5. Doc2_Rapp_Final_FFB_35_cout_interoperabilite2009.pdf.

[i.9] The general interoperability repository Version 2.0 - December 2015 drawn up by the French government's Inter-ministerial Directorate for the Digital Economy and the Information and Communication System.

NOTE: It lists standards for given use cases.
Scope of exchanges:

- in between administrations;
- in between administrations and businesses;
- in between administrations and citizens.

[i.10] W3C® Semantic Web: "Resource Description Framework (RDF)".

[i.11] W3C® Recommendation 16 July 2020: "JSON-LD 1.1 - A JSON-based Serialization for Linked Data".

[i.12] W3C® draft editor's: "The JSON-LD Vocabulary".

[i.13] JSON for linking data.

[i.14] Schema.org.

[i.15] ISO 23387: "Building information modelling (BIM) - Data templates for construction objects used in the life cycle of built assets - Concepts and principles".

[i.16] NF XP P07-150 published 12/2014: "Properties of products and systems used in construction. Definition of properties, methodology for creating and managing properties in a harmonized repository".

[i.17] ISO 16739-1 (2018): "Industry Foundation Classes (IFC) for data sharing in the construction and facility management industries - Part 1: Data schema".

[i.18] ISO 23386 (2020): "Building information modelling and other digital processes used in construction - Methodology to describe, author and maintain properties in interconnected data dictionaries".

[i.19] ISO 12006-3 (2022): "Building construction - Organization of information about construction works - Part 3: Framework for object-oriented information".

[i.20] ISO 19650 (all parts): "Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) - Information management using building information modelling".

[i.21] data-centrism: Source JDN 27/03/2019.

[i.22] EN 13501-1: "Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests" (produced by CEN).

[i.23] ISO 8601: "ISO 8601 is an International Standards Organisation standard that specifies the digital representation of date and time, based on the Gregorian calendar and the 24-hour time system respectively".

# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the following terms apply:

**appli-centrism:** IT development method consisting of developing an application using data that can only be used in this application

NOTE: This characterizes a method of developing computer applications which involves integrating the input data via a dedicated GUI for the processing envisaged by the application and outputting the processing in native format. In this case, the application acts as a data repository. According to this logic, the user should have as many data repositories as there are applications, and therefore as many use cases, which implies re-entering information or developing specific connectors for each link envisaged.

**BIM, Building Information Modelling:** use of a shared digital representation of a built asset (buildings, bridges, roads, factories, etc.) to facilitate the design, construction and operation processes and form a reliable basis for decision-making

NOTE: See ISO 19650 [i.20].

**class:** group of properties

**construction object:** according to ISO 23387 [i.15], this is an object of interest in the context of a construction process

**digital content:** digital content is a library or catalogue of objects that are collections of objects

**data-centrism:** IT development method involving the development of applications using standardized data that can be used in other applications

NOTE: Behind this name lies an approach that places data at the heart of the company and requires it to be considered as an asset in its own right, in the same way as patents, for example. It would be frustrating and incomprehensible to create a whole new business but not have this asset under control. The data centric approach is designed to turn things around and make data the cardinal point of a company's strategy. Source JDN 27/03/2019 [i.21].

**digital twin:** digital double of a physical entity or product

NOTE: In the world of construction, the Digital Twin makes it possible to describe the evolution of a model and its assets throughout their lifecycle. It enables them to be tracked and monitored from construction to deconstruction. It brings together a range of information from several processes: static data produced during construction (BIM, 2D models, etc.), simulation data, data collected via sensors and connected objects, data from AI (Artificial Intelligence), various cloud computing services (computer models enabling access to services via the Internet), maintenance and operating data (contract, service request, change order, etc.). Definition CSTB/Audrey VIAL.

**entity:** thing capable of independent existence, uniquely identifiable and capable of storing data

NOTE: In the context of the entity-relationship model, an entity has properties or attributes.

**eXtensible Markup Language (XML):** generic markup language that is a subset of the Standard Generalized Markup Language (SGML)

NOTE: Its syntax is said to be "extensible" because it can be used to define different languages, each with its own vocabulary and grammar, such as XHTML, XSLT, RSS, SVG, opendthX, etc.

**Garbage In Garbage Out:** well-identified risk in systems engineering

**Industry Foundation Classes (IFC):** standardized object-oriented file format [i.17] used by the construction industry to exchange and share information between software programmes, promoted by the international organization BUILDING SMART INTERNATIONAL and its national chapters

**IT object:** instance of the class

**JSON:** JavaScript Object Notation

NOTE: It is a textual data format derived from the object notation of the JavaScript language. It competes with XML for the representation and transmission of structured information.

**JSON LD:** JavaScript Object Notation for Linked Data

NOTE: Method for encoding structured data using JSON. The aim is to provide a simple way for developers to transform existing JSON data into JSON-LD. This makes it possible to serialize data in the same way as with traditional JSON. JSON-LD is a recommendation of the World Wide Web Consortium and is therefore considered a standard. Source Wikipedia. See [i.10], [i.11], [i.12], [i.13] and [i.14].

**open format:** freely usable data format

NOTE: Files in open format can be read and modified by yourself or by third parties. Readability is guaranteed over time. Open formats are freely usable in any software, making software interoperable. Open formats encourage freedom of choice by not favouring the format of a particular company (which is referred to as a native or proprietary format), thus avoiding the monopoly of a publisher who would like to make users captive to the proprietary format it has designed. See the april.org document.

**opendthX:** open data format designed to ensure interoperability between digital content and construction industry software

NOTE: This format is governed by the players in the construction industry through the non-profit association ALLIANCE DU BATIMENT.

**property:** descriptive element of an entity or relationship

NOTE: A "property" is a characteristic, within the meaning of standard NF XP P07-150 [i.16], of a product, a system, a project, etc. defined by a reference document. A property is not necessarily scalar, but may refer to a table, a plan, a photo, etc.

EXAMPLE: Reaction to fire measured in accordance with standard EN 13501-1 [i.22].

**static or intrinsic property:** property defined when the entity is manufactured, which cannot be modified during the life of the entity or the relationship

**dynamic or environmental property:** property which can be modified during the life of the entity or the relationship

**relationship:** association

NOTE: According to the entity-relationship model, is a link between at least two entities. A relationship can have properties or attributes.

**technical opinion (AT):** document formalizing the opinion issued by a group of experts on the suitability for use of innovative construction processes

NOTE: CSTB is involved in the technical opinion procedure at several levels and provides the secretariat. The CSTB has carried out a study showing the capacity of the opendthX format to describe AT.

## 3.2 Symbols

Void.

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

| | |
|---|---|
| ABV | Atelier BIM Virtuel (Virtual BIM Workshop) |
| AI | Artificial Intelligence |
| APD | Final design studies |
| API | Application Programming Interface |
| APS | Preliminary design studies |

| | |
|---|---|
| AT | Technical Opinion |
| BIM | Building Information Modelling |
| BMS | Building Management Systems |
| CAD | Computer Aided Design |
| cEndAt | Class expiry date |
| cId | Class identifier |
| CIQO | Collaboration In Quality Out |
| CMMS | Computerized Maintenance Management System |
| COPO | Cas d'usage, Objets d'usage, Propriétés, Objets modélisés |
| CRM | Customer Relationship Management |
| CSTB | Centre Scientifique et Technique du Bâtiment (Knowledge Centre of the building industry in France) |
| datBIM | The company that developed the opendthX format then licensed it to the ALLIANCE DU BATIMENT association to govern and promote it |
| DatSPIN | Up-to-date technical data for a digitised property strategy |
| DCE | Dossier de Consultation des Entreprises (Specification Document) |
| dId | Dictionary identifier |
| DOE | Dossier des ouvrages exécutés (As-built File) |
| DTU | Documents Techniques Unifiés (Unified Technical Documents) |
| ERP | Enterprise Resource Planning |
| GDP | Gross domestic product |
| GIGO | Garbage In Garbage Out |
| GTB | Gestion Technique du Bâtiment |
| GUI | Graphical User Interface |
| IFC | Industry Foundation Classes |
| IOT | Internet of Things |
| IPR | Intellectual Property Rights |
| IT | Information Technology |
| JDN | Journal Du Net |
| JSON | JavaScript Object Notation |
| JSON-LD | JavaScript Object Notation for Linked Data |
| LD | Link Data |
| mEndAt | Media expiry date |
| MIME | Multipurpose Internet Mail Extensions |
| oEndAt | Object expiry date |
| oId | Object identifier |
| opendthX | open harmonised technical dictionaries eXchange |
| PCBIM | BIM building permit |
| pEndAt | Property expiry date |
| pId | Property Identifier |
| POBIM | BIM object properties |
| PPBIM | BIM product properties |
| PTNB | Plan de Transition Numérique du Bâtiment (Digital Building Transition Plan) |
| rEndAt | Relationship expiry date |
| RGI | General interoperability reference framework |
| rId | Identifier of the object linked to the primary object |
| RSS | Really Simple Syndication |
| sendAt | Date and time the file was sent |
| SGML | Standard Generalized Markup Language |
| SVG | Scalable Vector Graphics |
| URI | Uniform Resource Identifier |
| XHTML | Extensible Hypertext Markup Language |
| XML | eXtensible Markup Language |
| XP | Experimental standards can be identified by their prefix "XP" |
| XSLT | eXtensible Stylesheet Language Transformations |

# 4 Introduction to Data Interoperability Format for Connected Buildings

The digital transformation of the construction industry can accelerate its environmental transformation, provided that it enables everyone to work together, which depends on the interoperability of data with applications.

The specific characteristics of the construction industry need to be taken into account if the transformation is to be a success:

- A fragmented industry: 99 % of companies have fewer than 20 employees (see Figure 4).
- High political stakes:
  - environmental: largest consumer of energy and largest producer of waste;
  - economic: trade in construction products accounts for 25 % of GDP;
  - social: 3rd sector in terms of direct recruitment after the service sector and industry.
- Digital modelling of construction projects, encouraged by public procurement regulations (see [i.1], [i.2] and [i.3]), provided that this requirement does not create technological barriers for any player.
- The costs attributable to lack of interoperability in France are estimated at several tens of billions of euros per year (see [i.7] and [i.8]).
- The cost of operating a building: 70 % to 80 % of its overall cost.
- Convergence between building and telecommunications via the IOT (Internet of Things or connected objects).
- Numerous IT applications: over 300 software providers in France alone.
- The digital transition of the building industry: from appli-centrism to open data-centrism.
- The need to develop a common language to ensure the interoperability of data with applications, in line with the principles of the European directives on data (see [i.5] and [i.6]) and the French initiative for a general interoperability repository (see [i.9]).

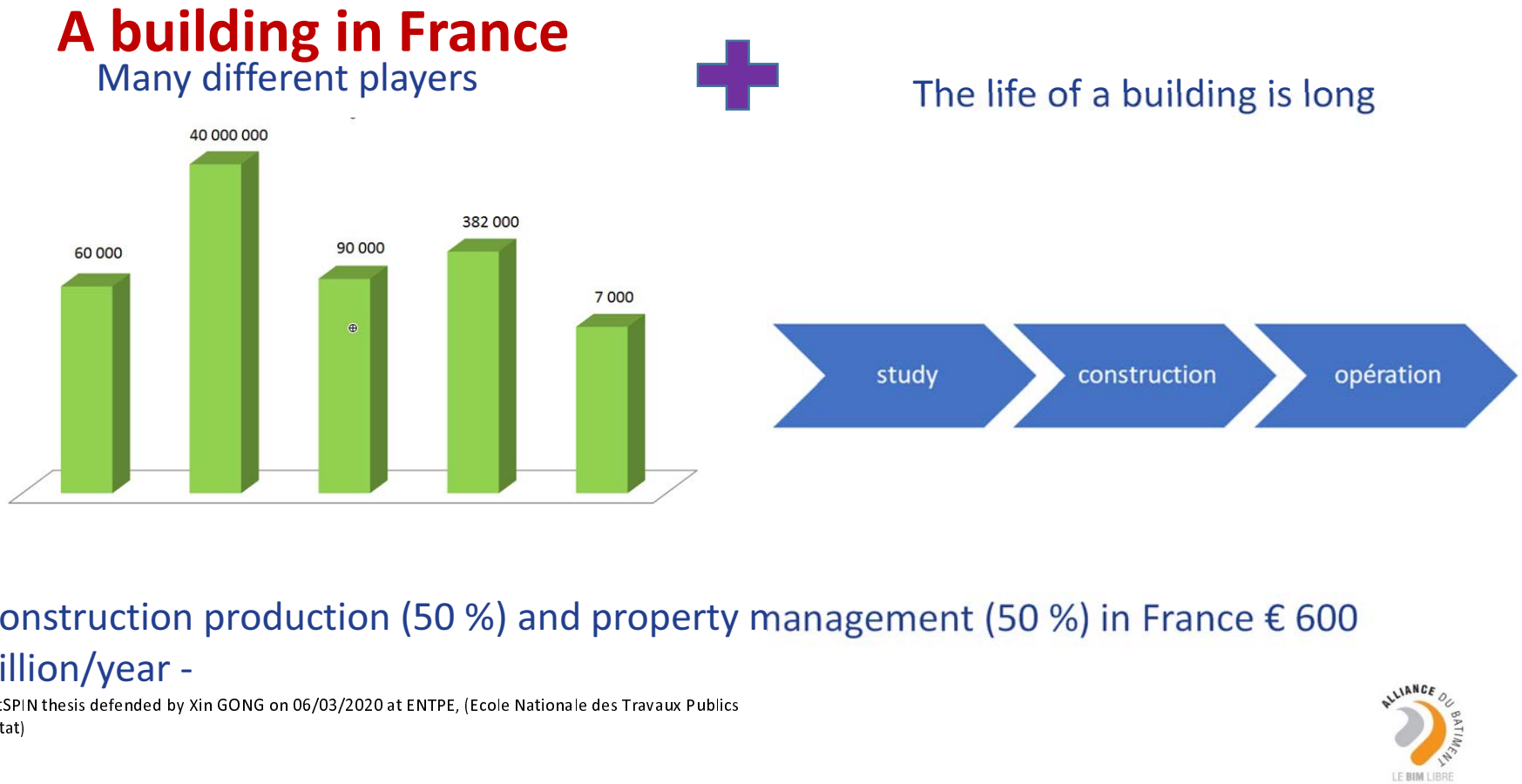

A building in France
Many different players
40 000 000
60 000
90 000
382 000
7 000
The life of a building is long
study
construction
opération
Construction production (50 %) and property management (50 %) in France € 600 billion/year -
DatSPIN thesis defended by Xin GONG on 06/03/2020 at ENTPE, (Ecole Nationale des Travaux Publics d'Etat)
ALLIANCE DU BATIMENT
LE BIM LIBRE

**Figure 4**

# Cost/benefit of interoperability in construction

Plan Transition Numérique dans le Bâtiment

2017 study

- Cost of collecting and entering information into software: 30 to 60 % of study budget

FFB FEDERATION FRANÇAISE DU BATIMENT

2009 study

- Cost of lack of interoperability for asset managers: €2,3/$m^2$/year
- Cost of interoperability failures to businesses estimated at 4 % of turnover

ALLIANCE DU BATIMENT LE BIM LIBRE

**Figure 5**

# 5 Data Interoperability Challenges

Interoperability is a regulatory requirement (see [i.4], [i.5] and [i.6]).

However, there are still a number of challenges to be met before data interoperability becomes widespread in practice:

- Raise user awareness of the value of data interoperability.
- Work across the industry to establish dictionaries of properties of general interest (regulatory requirements, generic use cases such as DTU, standards, TA, quantities, BMS, etc.).
- Reconcile the many use cases implemented during the design, construction and operation phases.
- Make exchange uses compatible with shared semantics and specific uses compatible with proprietary semantics by using a common grammar.
- Produce property dictionaries, libraries of generic object models and content catalogues in a universal format to encourage publishers to standardize the input data in their applications.
- Publish an open-source connector to content databases in a universal format to pool the development of connectors.

# 6 Interest of a format for the interoperability of data

Developing and standardizing a format to ensure the interoperability of data with applications has a number of benefits:

- Standardize input data in construction software to facilitate exchanges.
- Enrich the objects as the project progresses as part of a systems engineering approach to ensure digital continuity from design to operation of the construction works.
- Make digital exchange a common practice, independent of the applications used.
- Facilitate the production and use of digital content.
- Reduce the cost of producing and distributing digital content.
- Control the carbon cost of digital content.
- Encourage competition and innovation.
- Reduce dependency.
- Enforce interoperability regulations.

# 7 Interest of dynamic dictionaries to only exchange data for that specific use case

The data exchange format remains operational, while responding to changing needs through the use of dynamic property dictionaries:

- Responding to the changing needs of digital uses while keeping the data format, and therefore the connectors that use it, operational.
- Use existing standards to manage dynamic dictionaries (see ISO 23386 [i.18]).
- Apply the COPO method (Use Case, Used Objects, Properties, Modelled Objects) to develop new digital use cases.

- Enabling the use of multiple dictionaries produced by a multitude of communities, such as professional organizations or a community of players on a project, thanks to the agnostic nature of the opendthX format with regard to the dictionaries being used and the location on the internet they are being stored.

# 8 Practical applications of data interoperability

Here are a few examples of how data interoperability can be used, without being exhaustive of the possibilities available:

- Publish a library of generic object models that can be used in any type of application to deal with one or more use cases such as:
  - Collectively drawing up a DCE (Dossier de consultation des entreprises) in IFC format.
  - Editing a work proposal in IFC format.
  - Collectively drawing up a DOE (Dossier des ouvrages exécutés - the building's digital twin) in IFC format.
- Publish a catalogue of products or construction systems that can be used in any type of application.
- Query a catalogue from any application.
- Configure a product from any application.
- Download a product from any application.
- Query a connected object from any application.
- Control a connected object from any application.

# 9 The future of data interoperability

This is not an unrealistic dream, but simply the real application of intellectual property regulations (see [i.4]). Software is protected by intellectual property rights, except for the part that conditions its interoperability with a third-party application.

Data interoperability encourages exchanges, sharing, cooperation and open innovation This opens up new opportunities:

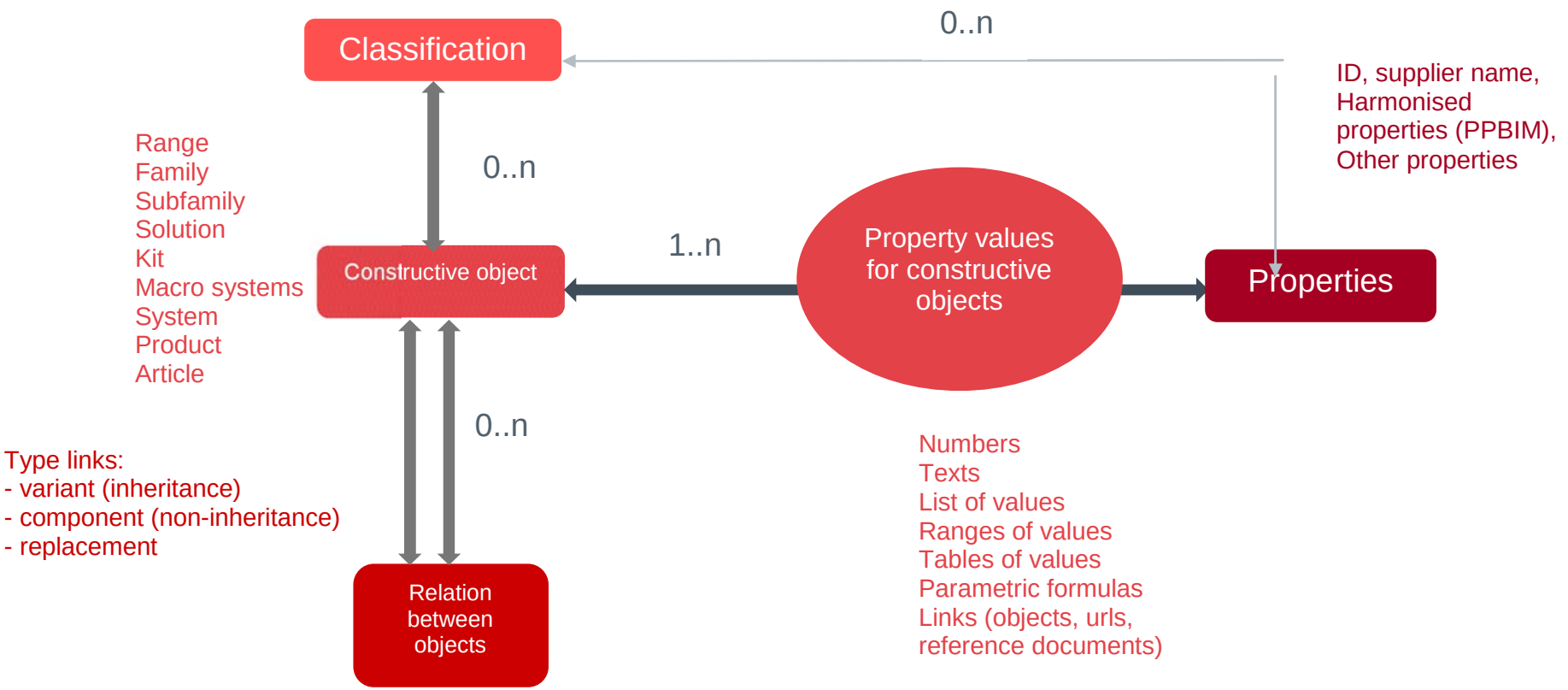
- Making exchanges between all the players more fluid and facilitating collaborative working to enable the construction industry to use digital technology more efficiently to meet the challenges facing our society:
  - Environment.
  - Fairness.
  - Competitiveness.
  - Inclusion.
- Collectively produce high-quality digital deliverables in the interoperable sense of the term, i.e. that can be shared and capitalized on.
- Use this mass-produced data to produce best practice rules that benefit as many people as possible.
- Ensure the sovereignty of professions and territories.
- Give meaning and strength to the collective.

# Annex A:
# Technical specification

## A.1 History of XML/XSD/JSON opendthX development

datBIM, which developed the opendthX format, opened it up in 2015, making its public documentation available at www.opendthx.org. Now licensed to the ALLIANCE DU BATIMENT association, it was originally an xml grammar and can now also be used in JSON format. Below are the various stages in the development of the opendthX format:

- Version 1.0 of the opendthX format (see diagram in Figure A.1) was documented in 2015. Initial work dates back to 2009, and it is based on Peter Chen's entity-relationship model.




http://www.opendthx.org

**Figure A.1**

- It has been revised on various occasions to support the development of open datBIM and then MydatBIM, and is now used in version 1.5. It is a grammar specified in xml.
- These developments have made it possible to distribute work carried out as part of the Building Digital Transition Plan (PTNB) and the BIM 2022 plan, such as:
  - POBIM (DCE use case based on 150 DTUs and 7 regulatory areas: dictionary of 3 200 properties describing 300 generic object models), the first experiment in the PPBIM standardization work (NF XP P 07-150 [i.16]), now ISO 23386 [i.18] and ISO 12006-3 [i.19].
  - VIRTUAL BIM WORKSHOP (APS-APD-PRO-DOE Collective housing).
  - PCBIM (Planning Permissions), which formalized the COPO method.
- A JSON API-REST was then developed, version 3 of which is now in production, to enrich the IFC model using the CiQo open-source application.
- The opendthX connector has been modularized connecteur.opendthx.org and released as open source.

# A.2 JSON-LD evolution

## A.2.1 Principles

The position paper proposes an example of the present document of opendthX concepts (entity, properties, relationships) as defined in the opendthX v2.0 technical appendix corresponding to the @context attribute of the JSON-LD. standard using the JSON language, with the following objectives:

- to facilitate the production of an IFC model with structured content in opendthX format:
  - with the integration of the notion of Pset to group together sets of properties;
- take into account static data (design-build) and dynamic data (operate):
  - introduce a flag (Boolean) attached to a Pset (with inheritance to attached properties) or to a property:
    - dynamic attribute (true or false);
- harmonise with the JSON-LD standard:
    - when an JSON LD concept is identified that can replace an opendthX concept, the JSON LD concept is integrated and the opendthX format is enriched with the concepts listed below: multilingual;
    - multi-document graphs for on-demand use of data (optimization of bandwidth: digital sobriety).

## A.2.2 Example

### A.2.2.1 Conventions

The opendthX conventions for JSON attributes are defined below:

- Attribute names will use the camelCase style. Examples: objectName, datbimCode, etc.
- The order of compound attribute names is as follows: the main word first, then the qualifier(s). Examples: portalId, portalUrl.
- Identifiers will have the suffix Id. Names will have the suffix Name. Dates will have the suffix At.
- Boolean attributes are prefixed with is.

- Attributes linked to a constructive object (constructive entity in v1.x) will have an o prefix. Examples: oId, oName.
- Attributes linked to a property will be prefixed with p. Examples: pId, pName.

### A.2.2.2 Syntax

The syntax of the opendthX concepts (entity, properties, links) corresponding to the @context attribute of the JSON LD standard is summarized in Table A.1.

**Table A.1: Table of key values**

| Key | Occurrence | Path | Format value | Equivalence v.1.x | Comments |
|---|---|---|---|---|---|
| **@context** | 0..1 | @context | URL | | Link to the semantics of this format. |
| **dicts** | 1..1 | dicts | - | | All reference systems. |
| **dicts[d]** | 1..n | dicts[d] | - | | Referential or dictionary or classification. |
| **dId** | 1..1 | dicts[d].dId | Alphanumeric | @default-dictionnary | Dictionary identifier. Mandatory. Used by oId, pId, cId. |
| **dName** | 0..1 | dicts[d].dName | Alphanumeric | | Dictionary name. |
| **dUri** | 0..1 | dicts[d].dUri | URI/URL | | Link to the dictionary. |
| **objects** | 1..1 | objects | - | entities | Set of objects with their properties, relationships, media and classes. |
| **objects[i]** | 1..n | objects[i] | - | entity | Each occurrence of `objects` corresponds to a constructive object. |
| **oId** | 1..1 | objects[i].oId | Alphanumeric | @id | Object identifier. Mandatory. |
| **oDict** | 0..1 | objects[i].oDict | Alphanumeric | @id | Object repository (manufacturer, standard, etc.). Optional. |
| **oName** | 0..1 | objects[i].oName | Alphanumeric | entity | Object name. Optional. |
| **oStartAt** | 0..1 | objects[i].oStartAt | date-time (format ISO 8601 [i.23]) | @application-date | Date of application of the object. Optional. |
| **oEndAt** | 0..1 | objects[i].oEndAt | date-time (format ISO 8601 [i.23]) | @expiration-date | Object expiry date. Optional. |
| **oUri** | 0..1 | objects[i].oUri | URI | @url | URL of the object page. Optional. |
| **properties** | 0..1 | objects[i].properties | | properties | Set of object properties and their values. |
| **properties[j]** | 1..n | objects[i].properties[j] | | property | A property and its object value. |
| **pId** | 1..1 | objects[i].properties[j].pId | Alphanumeric | @id | Property identifier. Mandatory. |
| **pDict** | 0..1 | objects[i].properties[j].pDict | Alphanumeric | @id | Object repository (manufacturer, standard, etc.). Optional. |
| **pName** | 0..1 | objects[i].properties[j].pName | Alphanumeric | entity | Object name. Optional. |

| Key | Occurrence | Path | Format value | Equivalence v.1.x | Comments |
|---|---|---|---|---|---|
| **pStartAt** | 0..1 | objects[i].properties[j].pStartAt | date-time (format ISO 8601 [i.23]) | @application-date | Date of application of the property. Optional. |
| **pEndAt** | 0..1 | objects[i].properties[j].pEndAt | date-time (format ISO 8601 [i.23]) | @expiration-date | Property expiry date. Optional. |
| **pUri** | 0..1 | objects[i].properties[j].pUri | URI | @link | Uri address of the property resource. Optional. |
| **pUnit** | 0..1 | objects[i].properties[j].pUnit | Alphanumeric | @unit | Unit of measurement of property value. Optional. |
| **pIsDyn** | 0..1 | objects[i].properties[j].pIsDyn | Booléen | | Dynamic property? Optional. |
| **pValue** | 0..1 | objects[i].properties[j].pValue | Booléen, numéric, Alphanumeric, tableau | value, link, text, array or matrix | Property value. Optional. |
| **pNotes** | 0..1 | objects[i].properties[j].pNotes | Alphanumeric | remarks | Notes on the value of the property. Optional. |
| **relations** | 0..1 | objects[i].relations | | relations | All the object's relationships. |
| **relations[k]** | 1..n | objects[i].relations[k] | | relation | An object relationship. |
| **rId** | 1..1 | objects[i].relations[k].rId | Alphanumeric | @ref | Identifier of the object linked to the primary object. Mandatory. |
| **rDict** | 0..1 | objects[i].relations[k].rDict | Alphanumeric | | Reference for the linked object (manufacturer, standard, etc.). Optional. |
| **rType** | 1..1 | objects[i].relations[k].rType | "includes", "extends " or "replaces" | @type | Type of relationship between the 2 objects. Mandatory. |
| **rStartAt** | 0..1 | objects[i].relations[k].rStartAt | date-time (format ISO 8601 [i.23]) | @application-date | Date of application of the relationship. Optional. |
| **rEndAt** | 0..1 | objects[i].relations[k].rEndAt | date-time (format ISO 8601 [i.23]) | @expiration-date | Relationship expiry date. Optional. |
| **medias** | 0..1 | objects[i].medias | | medias | All the object's media. |
| **medias[m]** | 1..n | objects[i].medias[m] | | media | An object medium. |
| **mType** | 1..1 | objects[i].medias[m].mType | type MIME | @media-type | Media MIME type. Mandatory. |
| **mEncoding** | 1..1 | objects[i].medias[m].mEncoding | "url", "base64", "base64url", "qp" | @format | Media encoding format. Mandatory. |
| **mValue** | 1..1 | objects[i].medias[m].pValue | URL or media content | media | |
| **mStartAt** | 0..1 | objects[i].medias[m].mStartAt | date-time (format ISO 8601 [i.23]) | | Media application date. Optional. |
| **mEndAt** | 0..1 | objects[i].medias[m].mEndAt | date-time (format ISO 8601 [i.23]) | | Media expiry date. Optional. |
| **classes** | 0..1 | objects[i].classes | | classes | Set of object classes. |
| **classes[j]** | 1..n | objects[i].classes[n] | | class | An object class. |
| **cId** | 1..1 | objects[i].classes[n].cId | Alphanumeric | class | Class identifier. Mandatory. |

| Key | Occurrence | Path | Format value | Equivalence v.1.x | Comments |
|---|---|---|---|---|---|
| **cDict** | 0..1 | objects[i].classes[n].cDict | Alphanumeric | class | Class reference (classification). Optional. |
| **cStartAt** | 0..1 | objects[i].classes[n].pStartAt | date-time (format ISO 8601 [i.23]) | @application-date | Date of application of the class. Optional. |
| **cEndAt** | 0..1 | objects[i].classes[n].pEndAt | date-time (format ISO 8601 [i.23]) | @expiration-date | Class expiry date. Optional. |
| **meta** | 1..1 | meta | - | | Metadata |
| **v** | 1..1 | meta.v | Numéric | version | Version of each JSON |
| **sendAt** | 1..1 | meta.sendAt | date-time (format ISO 8601 [i.23]) | creation-date | Date and time the file was sent. |

### A.2.2.3 Illustration

Below is an example of a description of Soprema's AQUADERE product in opendthX v2.0 format:

```
{
  "@context": "https://www.opendthx.org/w/opendthx20",
  "dicts": [
    {
      "dId": "SOPREMA",
      "dUri": "https://soprema.fr/liste-produits.html"
    },
    {
      "dId": "datBIM",
      "dUri": "https://datBIM.org/dictionnaires.html"
    }],
  "objects": [
    {
      "oId": "D10-AQUADERE",
      "oDict": "SOPREMA",
      "oName": "AQUADERE",
      "oStartAt": "2013-12-02T11:21:31+01:00",
      "oUri" : "https://open.datbim.com/Produit-AQUADERE-1498632193626.html",
      "properties": [
        {
          "pId": "121564",
          "pDict": "datBIM",
          "pName": "Matériaux",
          "pValue": "Bitume - Liquide"
        },
        {
          "pId": "8362",
          "pDict": "datBIM",
          "pName": "Longueur (dimension utile)",
          "pUnit": "mm",
          "pValue": 1000
        },
        {...}, ''autres propriétés'', {...}
       ]
    },
    {...}, ''autres objets'', {...}
  ],
  "meta": {
    "v": 1,
    "sendAt": "2023-08-08T17:18:25Z"
  }
}
```

## A.3 opendthX roadmap

The group proposes to develop an actual proof of concept according to the following roadmap:

- Document the JSON-LD concepts of @type, @id, @language, @value, etc. in a more formal way, readable and interpretable by both humans and machines.
- Develop a proof of concept to convince both decision makers and developers.
- Implement this formalized version of the API, compliant with opendthX v2.0 JSON-LD in both platforms datBIM and ThorbiQ, to be able to exchange data.
- Make the API self-discoverable by applying the openAPI specification to enable automatic connection to a digital content repository with an API delivering data in opendthX V2.0 JSON-LD format.

## A.4 Licence to use the opendthX format

The opendthX format is a creation of:

- the company datBIM, S.A with a capital of 106 600 €;
- SIREN number 433334349;
- whose registered office is at 432 route du Bourg - 38620 Montferrat;
- represented by Didier BALAGUER acting in his capacity as Chairman and Chief Executive Officer.

Use of the opendthX format is subject to acceptance of the terms of the "Creative Commons Attribution No Derivative Works 3.0 France" licence, which can be viewed at http://creativecommons.org/licenses/by-nd/3.0/fr/legalcode.

The opendthX format is licensed to the ALLIANCE DU BATIMENT association, which is governed by the voluntary players in the construction industry.

# Annex B: Bibliography


- European Data Governance Directive: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0868.
- Proposal for a European data directive (European data act): https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52022PC0068.
- Study report on the comparative estimate of the cost of creating a technical database of digital mock-up components: Doc1_Etude2_ABV_BDD_20170411.pdf.
- General interoperability reference framework (RGI): https://www.numerique.gouv.fr/uploads/Referentiel_General_Interoperabilite_V2.pdf.
- Assessment of the costs of interoperability faults incurred by companies, project owners and operators in the construction and operation of buildings: Doc2_Rapp_Final_FFB_35_cout_interoperabilite2009.pdf.
- CSTB study report showing the capacity of the opendthX format to describe technical opinions: Doc3_Rapport_final_v1.4_CSTB_AT_OpendthX.pdf.
- Open format documentation: Doc4_format_ouvert_april.pdf.
- Entity-relationship model: https://fr.wikipedia.org/wiki/Mod%C3%A8le_entit%C3%A9-association.
- Version 1.0 opendthX format: http://www.opendthx.org/w/Open_dthX_v1.0.
- Version 1.5 opendthX format: http://www.opendthx.org/w/Open_dthX_v1.4.
- POBIM repository: https://open.datbim.com/Fournisseur-POBIM-386798.html.
- ABV repository: https://open.datbim.com/Fournisseur-Atelier_BIM_Virtuel_1_Objets_par_phases_cumulees-386940.html.
- PCBIM repository: https://open.datbim.com/Fournisseur-PCBIM-387443.html.
- Open source opendthX connector: https://connecteur.opendthx.org.
- Documentation opendthX: http://www.opendthx.org.
- datBIM API documentation: https://rest-api-rw.datbim.com/api/doc.

# History

| Document history | | |
|---|---|---|
| V1.1.1 | February 2024 | Publication |
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