# Semantic Interoperability using Ontologies and Standards for Building Product Properties

He Tan, Rahel Kebede, Annika Moscati and Peter Johansson

Department of Computing,
Department of Construction Engineering and Lighting Science,
School of Engineering, Jönköping University, Sweden

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# Product Properties and BIM

→ BIM at the level 3 --> a high level of integration and interoperability.

→ Properties need to be created in a manner to support this goal.

→ Product properties is one of the central focuses within the context of BIM.



| | Level 0 | Level 1 | | Level 2 | Level 3 | |
|---|---|---|---|---|---|---|
| | | **2D** | **3D** | **Federated BIMs** | **Integrated BIM** IDM, IFC, IFD | |
| | **CAD** | Proprietary Formats | | Proprietary formats + COBie | ISO standards | Exchange Formats |
| | Drawings | Geometric models | | Coordinated Discipline specific BIM models | Integrated, interoperable Building Information Models for the entire life-cycle | Depth of information |
| | Paper | File-based collaboration | | Central manage-ment of files (Common Data Environment), Shared libraries | Cloud-based model management (BIM Hub) | Coordination and Collaboration |

# The Challenges

→ The challenges in achieving interoperability between manufacturers' product databases and the BIM platform.

  – Manufacturers are forced to create BIM objects in different formats for different BIM authoring platforms.

  – On the other hand, it is difficult for building designers to find suitable BIM objects.

→ The goal of the work is to use standards and ontologies to address the challenges.

→ Standards and ontologies have been identified as the solutions for semantic interoperability for long time in computer science.

# Semantic Interoperability
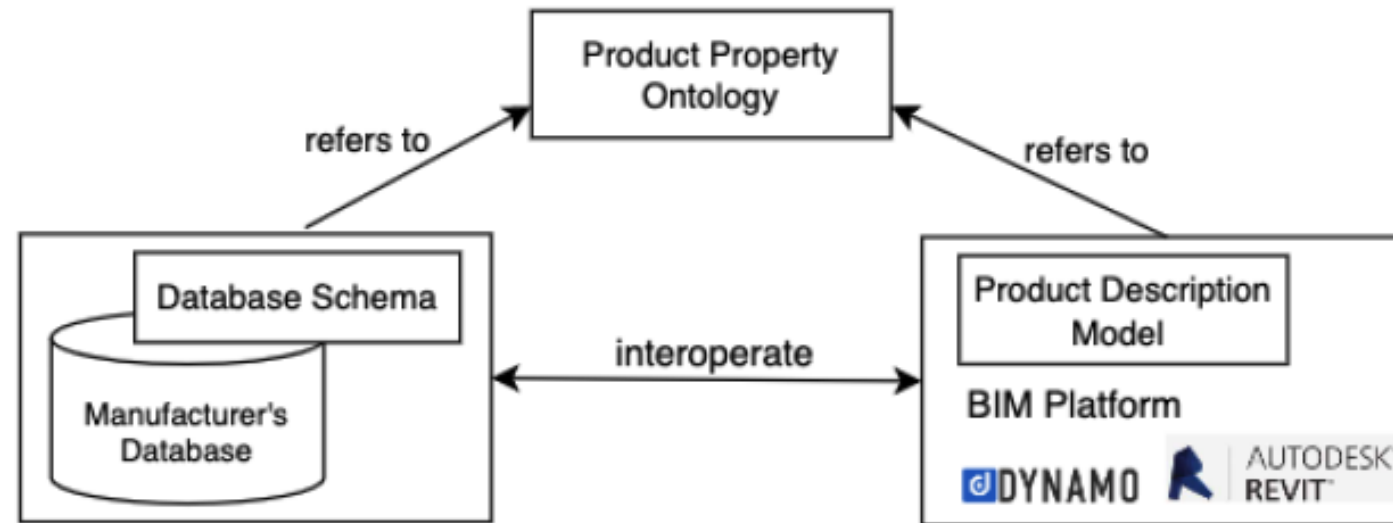
# The Standard EN ISO 23386:2020

→ It is a standard that specifies the requirements on describing, authoring and maintaining properties used in the construction industry.

- It intends to establish interoperability between data dictionaries and build a network of the data dictionaries for properties.
- The mappings between the terms used in the interconnected data dictionaries need to be maintained.
- Each property is described by several attributes.
- Each property should be identified by a globally unique identifier (GUID).

# Technical Specification (CEN/TS) SIS-CEN/TS 17623

→ The standard has been developed specifically for the products used in lighting systems.

→ It is built on EN ISO 23386:2020.

→ The Technical Committee ISO/TC 274 Light and Lighting in cooperation with CIE Joint Technical Committee 6 is currently conducting the work of producing an ISO standard specifically for lighting product properties, based on this standard.
https://www.iso.org/committee/4418564.html

→ Given the great number of products used in the construction industry, one solution is to undertake standardization work for different categories or groups of product categories.

# Product Properties in Data Dictionaries

→ Data dictionaries are standards too?

| Standard | Domain | Format | GUID | Interconnected |
|---|---|---|---|---|
| Uniclass | multi-disciplines | tables, API | No | No |
| MasterFormat | multi-disciplines | tables, API | No | No |
| UniFormat | multi-disciplines | tables, API | No | No |
| ETIM | technical products | XML | No | No |
| IFC Schema | multi-disciplines | EXPRESS, XSD, ifcOWL | Yes | No |
| bSDD | multi-disciplines | tables, JSON, RDF, XML, API | Yes | Yes |
| CoClass | multi-disciplines | API | No | Yes |

→ bsDD has made effort to conform to EN ISO 23386:2020.

# Ontologies for Product and Product Properties

→ The BIMSO ontology and The BIMDO ontology (Building Design Ontology)

→ The Building Topology Ontology (BOT)

→ Product and product properties in ifcOWL

→ The Building Product Ontology (BPO)

→ The Ontology for Property Management (OPM)

→ Interconnected Data Dictionary Ontology (IDDO)

→ An API to generate an OWL ontology using the terms retrieved from bsDD data dictionaries

# Standards and Ontologies

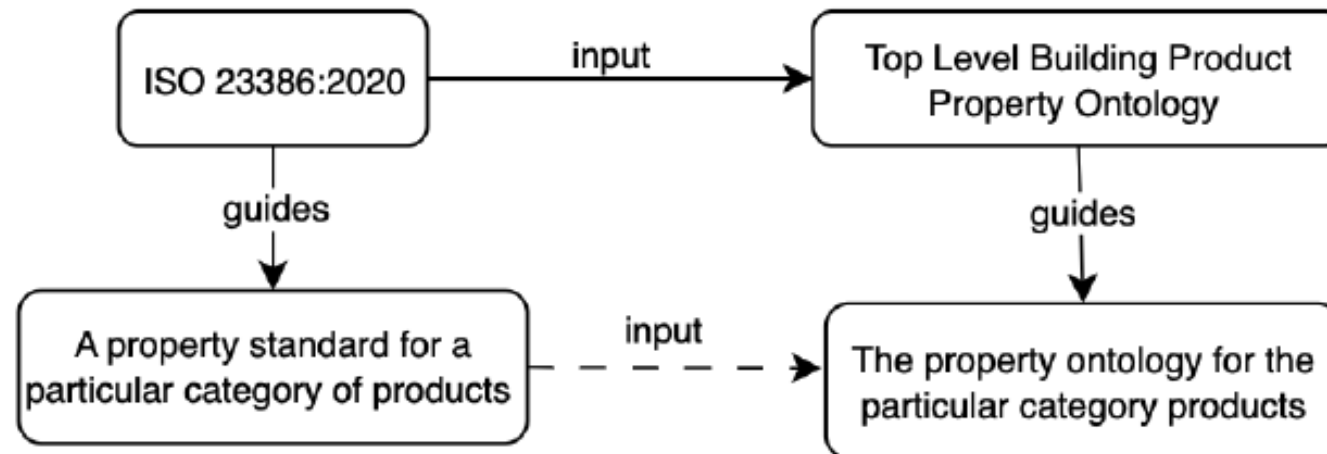→ Utilize both standards and ontologies to support interoperability



**Figure 1:** The ontology development process

# EN ISO 23386:2020

| Name | Description | Example | Interconnected dictionaries management rule | Request form management rule | Type | List of values |
|---|---|---|---|---|---|---|
| globally unique identifier | globally unique identifier generated using an algorithm in conformity with standard ISO/IEC 11578:1996 See RFC4122 | 936DA01F-9ABD-4D9D-80C7-02AF85C822A8 | Mandatory, calculated | | String Single-value | |
| Status | Status of the property during its life cycle. | | Mandatory Calculated | | enumeration Single-value | Active Inactive |
| Date of creation | Date of validation of the property creation request. | 2014-04-30T10:39:53Z | Mandatory Calculated | | Date In accordance with ISO 8601 Format=YYYY-MM-DDThh:mm:ssTZD | |
| ... | | | | | | |
| Country of use | Country in which the property is used. | FR US | Mandatory | Mandatory | Choose multiple-values | In accordance with ISO 3166-1 |

**Figure 2:** Example property attributes specified in EN ISO 23386:2020

# A Fragment of the BPPO (Building Product Properties Ontology)

→ The ontology is expressed using OWL.
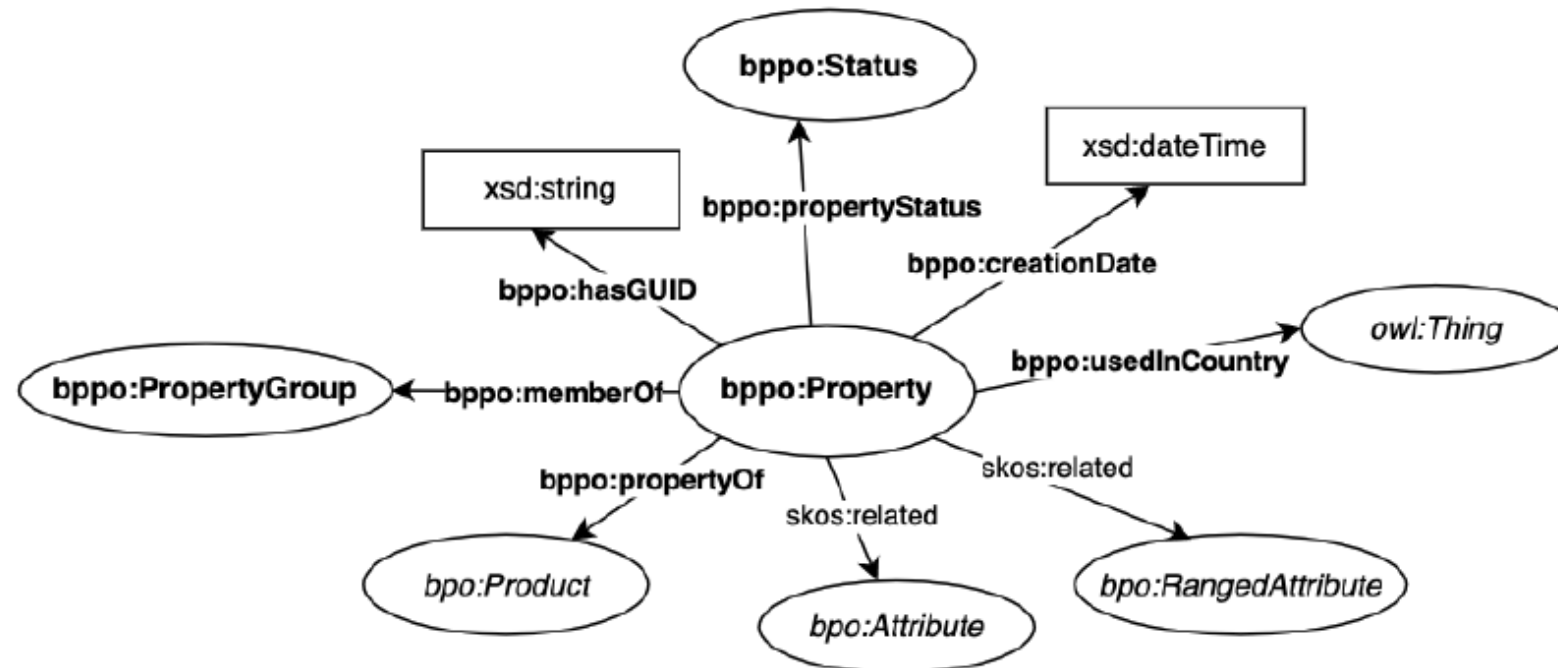
# SIS-CEN/TS 17623:2021

Table 1 — Mechanical properties

| GUID | ID | Name | Description | Symbol | Format, Unit | Value set | Examples |
|------|-----|------|-------------|--------|--------------|-----------|----------|
| 2GZ1YB8enFVhDHOKgLc$BU | 01–0001 | overall diameter | Overall diameter of the housing of the luminaire or sensing device. | | 1E0, mm | n.a. | |
| 19Z9XKYDT4p8HR0ZbD$wO_ | 01–0002 | height | Height of the housing of the luminaire or sensing device. Corresponds to z-axis, gamma angle 180° and 180° vertical of the light distribution curve. This definition is regardless of orientation of luminaires. See Figure 1. | | 1E0, mm | n.a. | |
| ... | | | | | | ...... | |
| 1LrBLaYtnCARKperF_2Ykh | 01–0017 | glow wire resistance | The glow wire test for fire hazard (see EN 60695-2-10) to test electrical products, assemblies or individual components. | | 1E0, °C | 550°C, 650°C, 750°C, 850°C, 960°C | |

**Figure 4:** Example properties specified in SIS-CEN/TS 17623:2021

# A Fragment of the LPPO (Lighting Product Property Ontology)
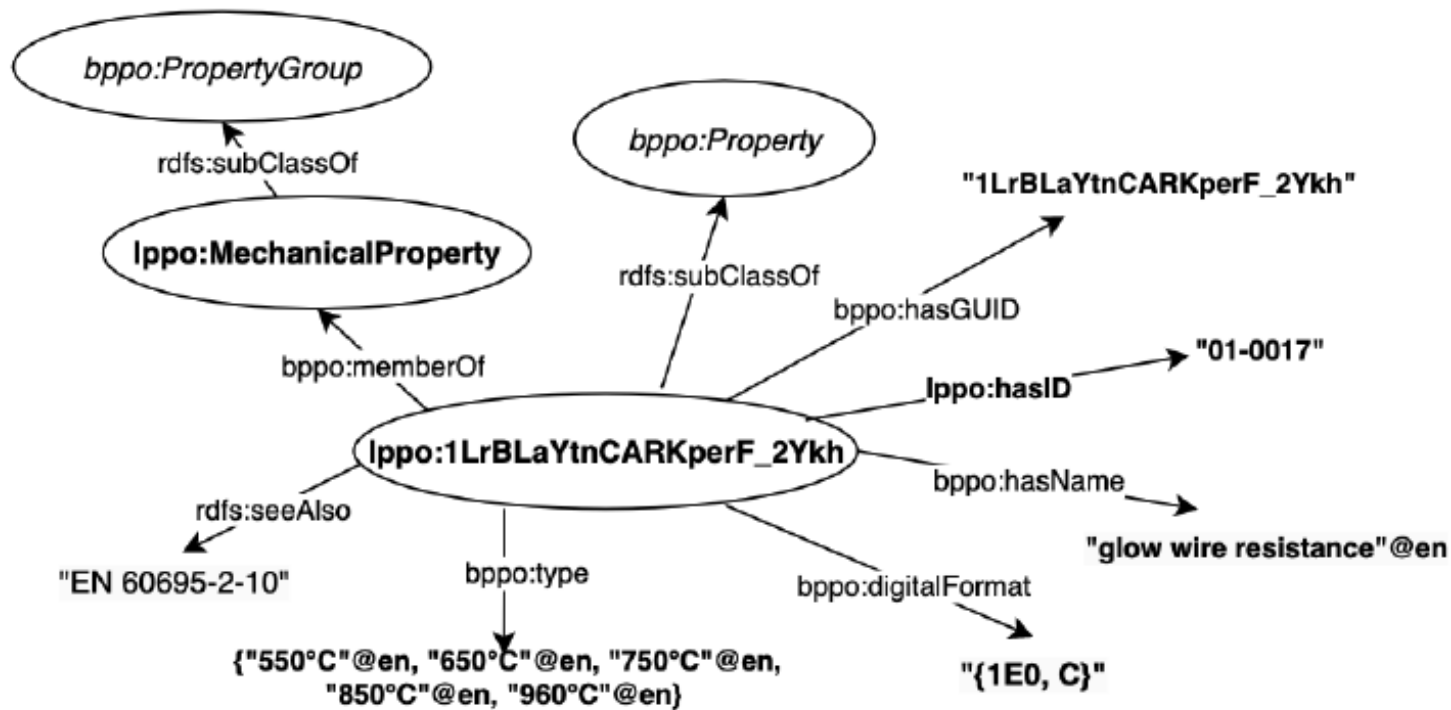
# The Architecture
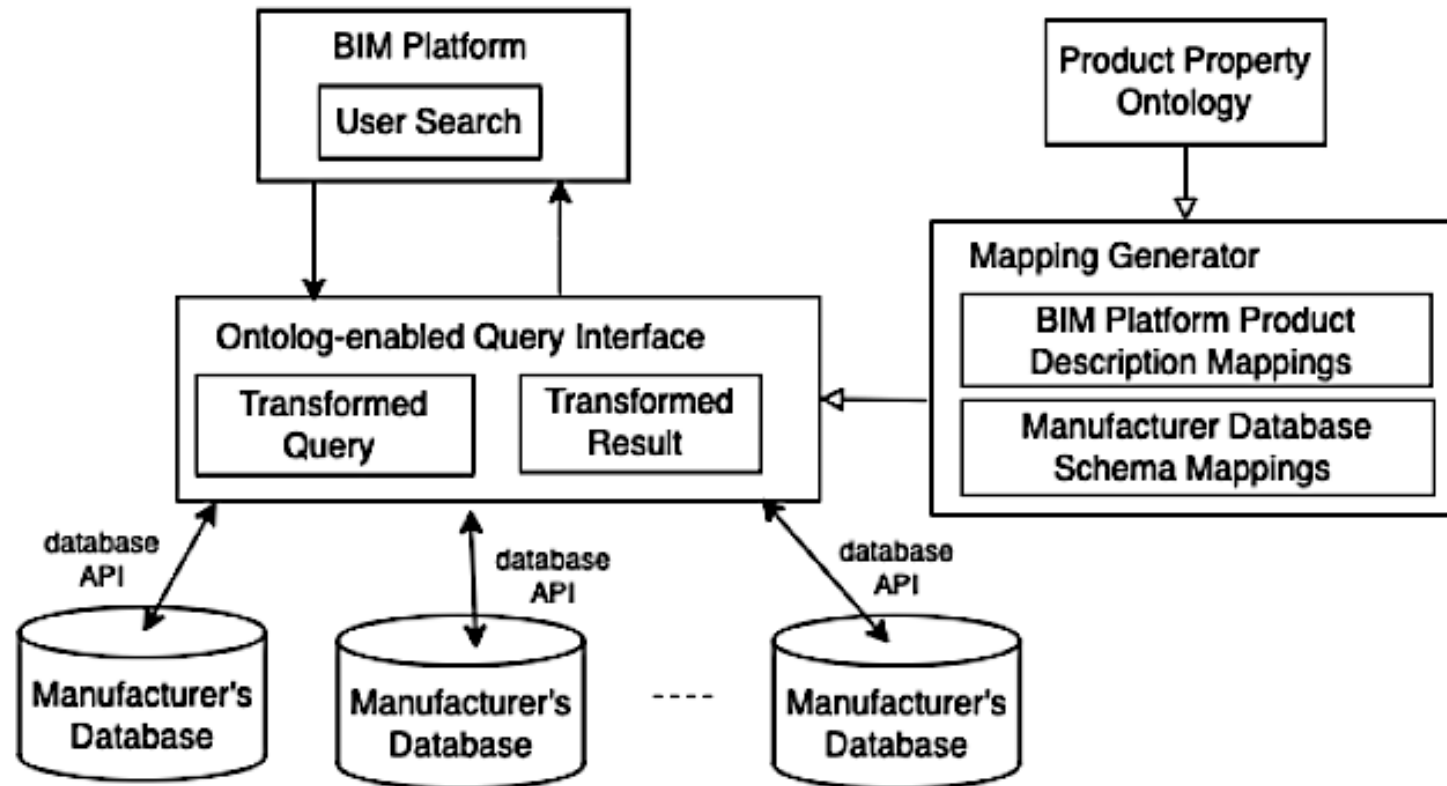
# Conclusions

→ Two ontologies of properties for products used in the construction industry.

→ How to build the ontologies conformed to property standards.

→ How to support semantic interoperability using standards and ontologies

→ Future work
  – build a network of product property ontologies.
  – ontologies can be developed from standards but also data dictionaries.
  – experiment with different implementation of the architecture