



Linked Data and Semantic Web

Link to slides: <http://tiny.cc/7y4ukz>



2011

BSc Architectural Engineering

DTU



2011

BSc Architectural Engineering

2013

MSc Architectural Engineering

DTU

DTU



2011

BSc Architectural Engineering

2013

MSc Architectural Engineering

2013-
2016

HVAC Engineer

Axel Towers | Bispebjerg Hospital lab&log

DTU

DTU

ALECTIA
NIRAS



2011	BSc Architectural Engineering
2013	MSc Architectural Engineering
2013-2016	HVAC Engineer Axel Towers Bispebjerg Hospital lab&log
2016-2019	Industrial PhD Digital Infrastructure and BIM in the design and planning of building services

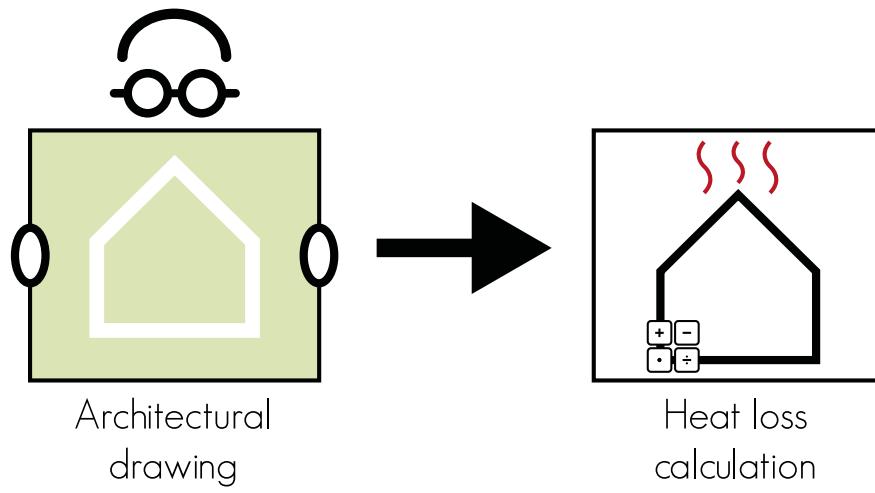


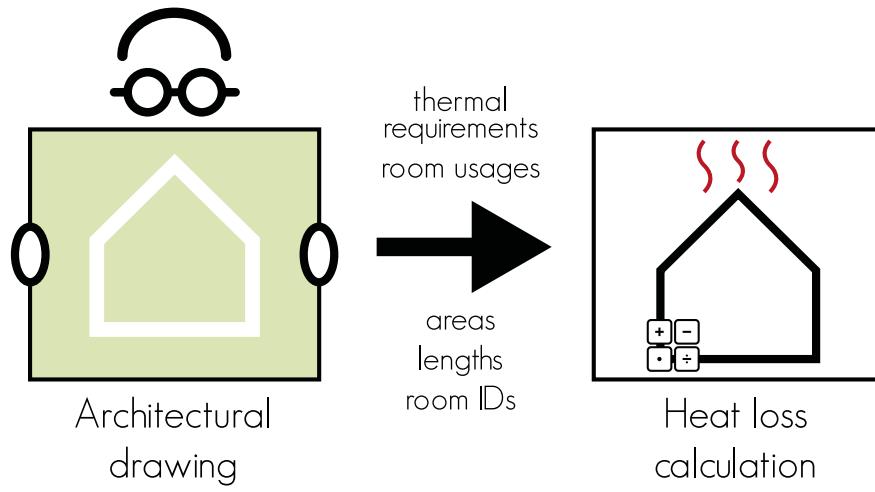


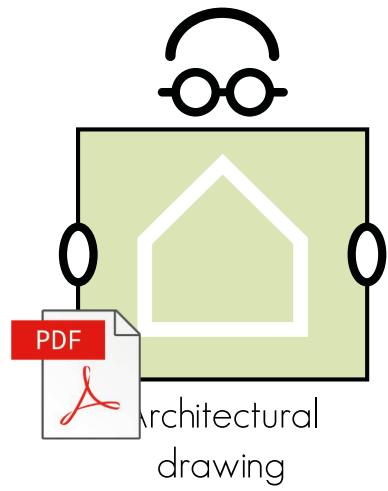
2011	BSc Architectural Engineering	DTU
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2013-2016	HVAC Engineer Axel Towers Bispebjerg Hospital lab&log	ALECTIA NIRAS
2016-2019	Industrial PhD Digital Infrastructure and BIM in the design and planning of building services	DTU NIRAS
2019-	Niras web-BIM	NIRAS

Some personal statements

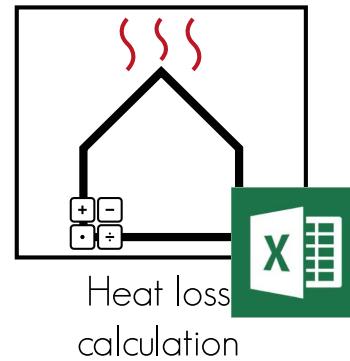
"Our industry works in a document-centric manner
rather than a data-centric one"

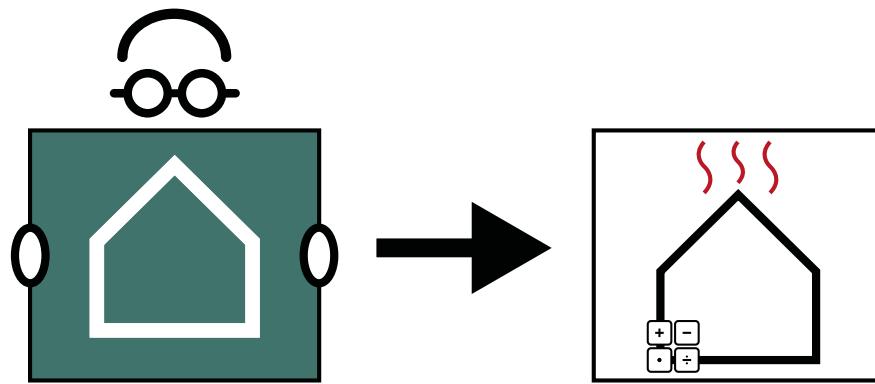


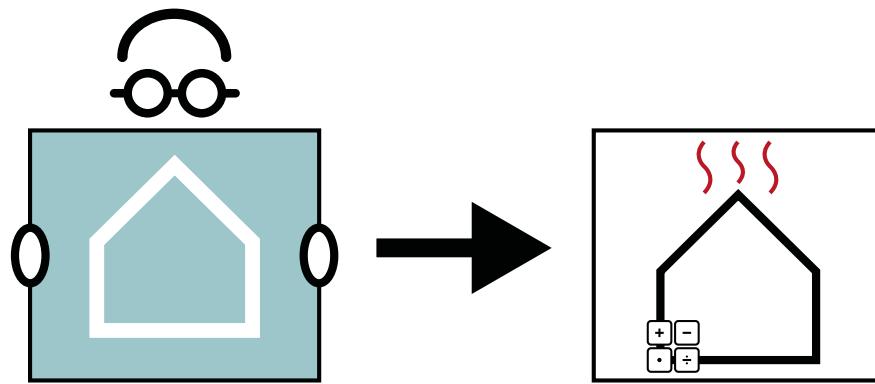


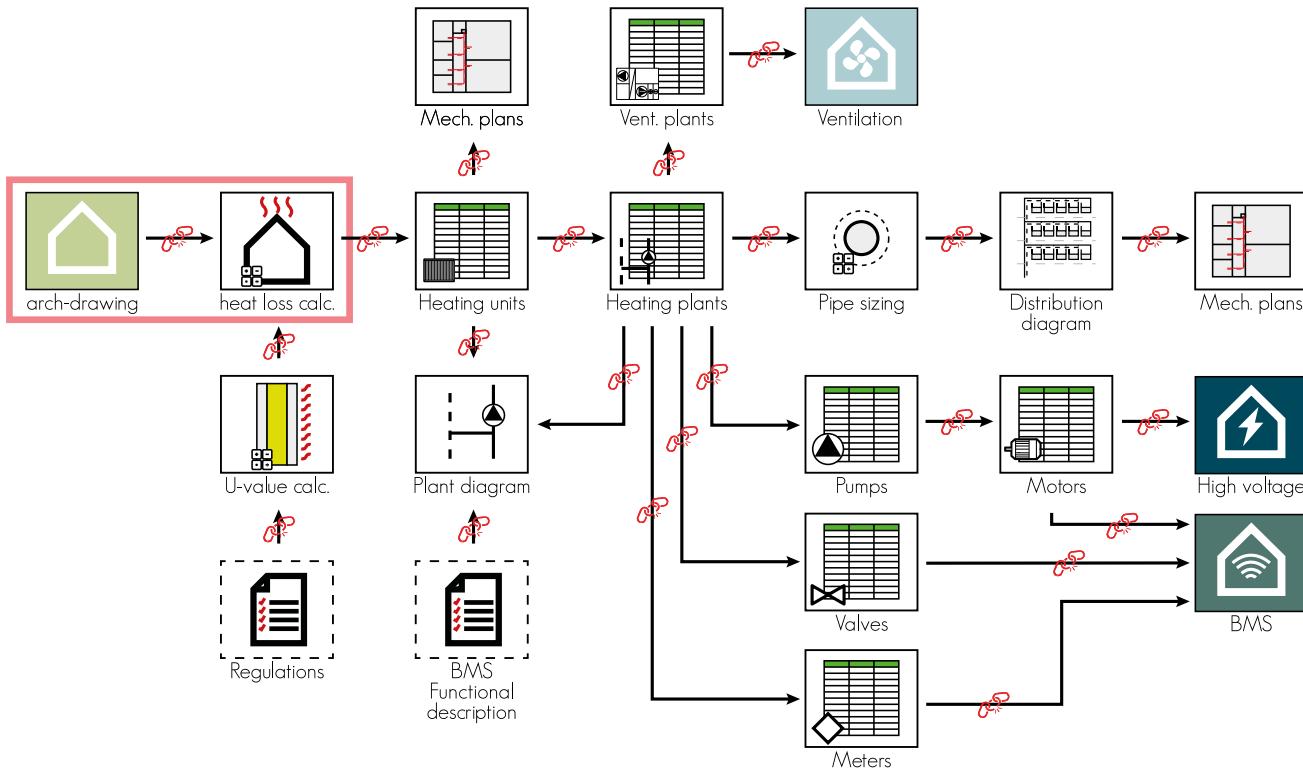


thermal
requirements
room usages
areas
lengths
room IDs

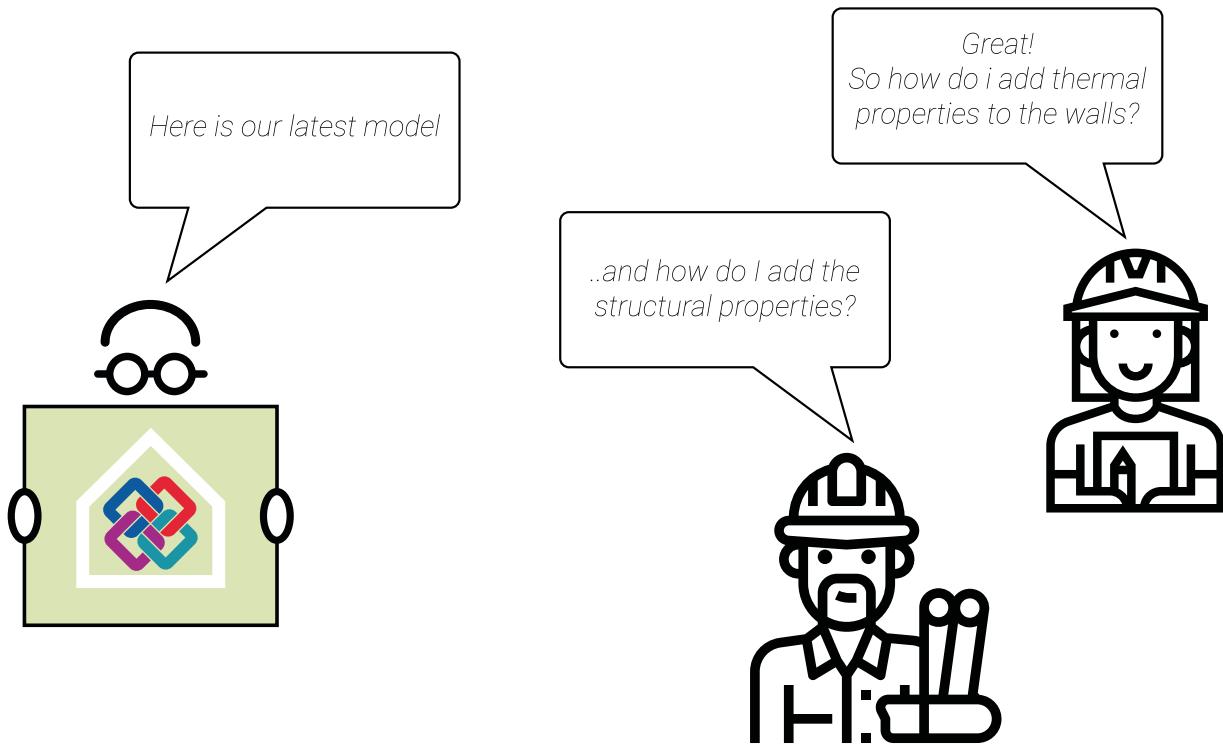


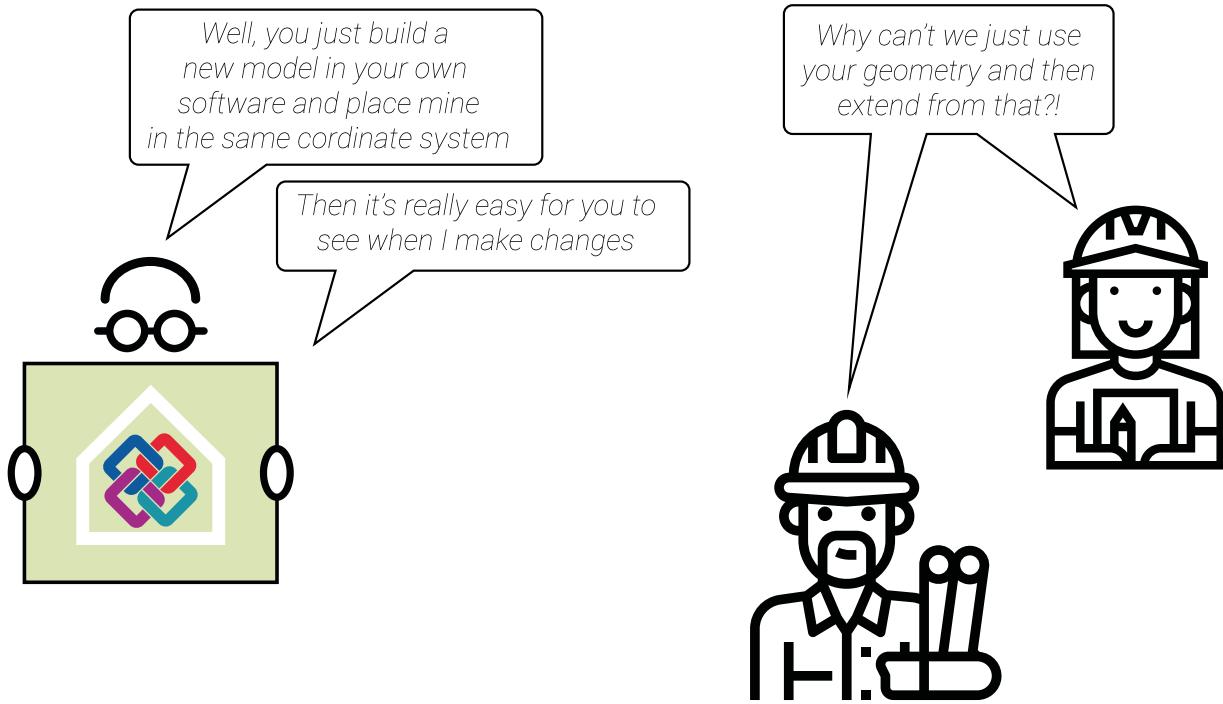




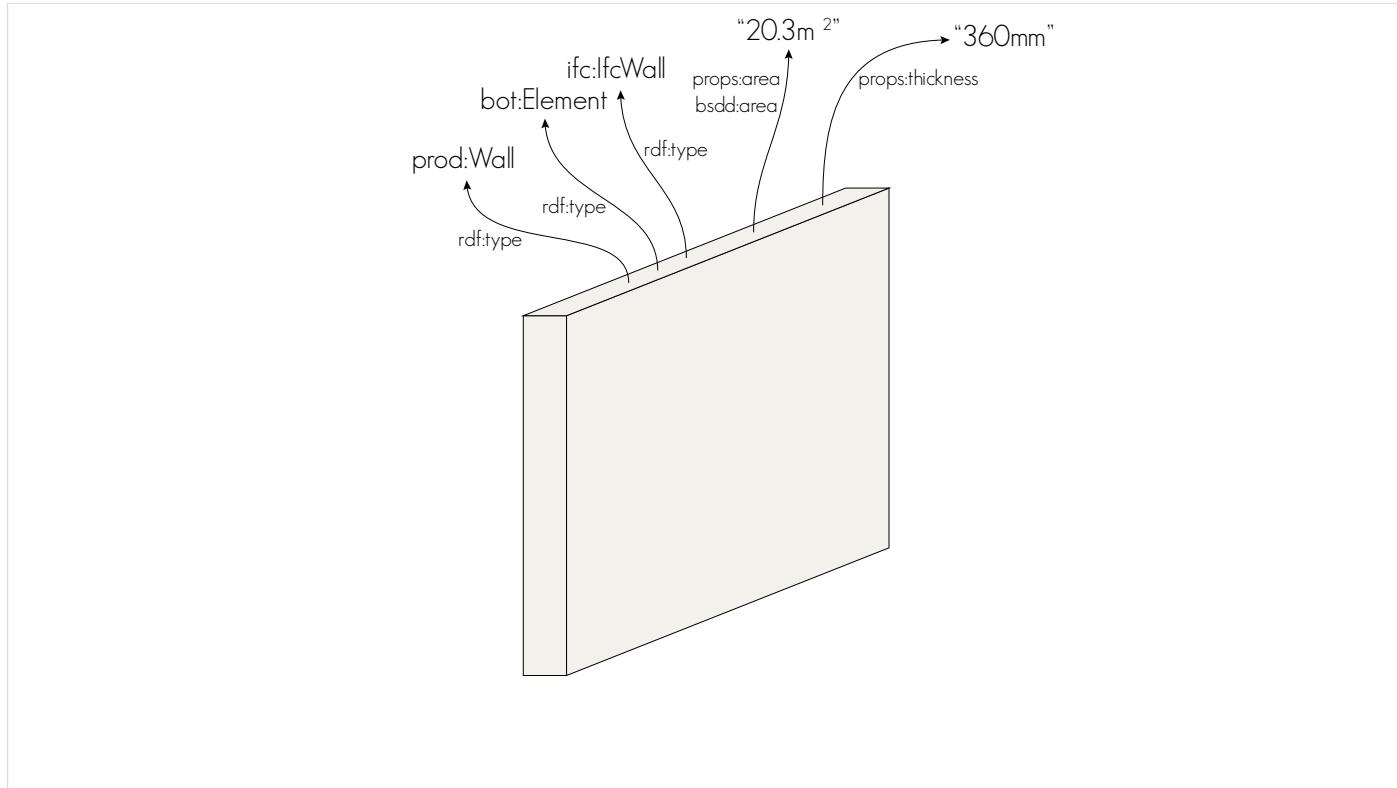


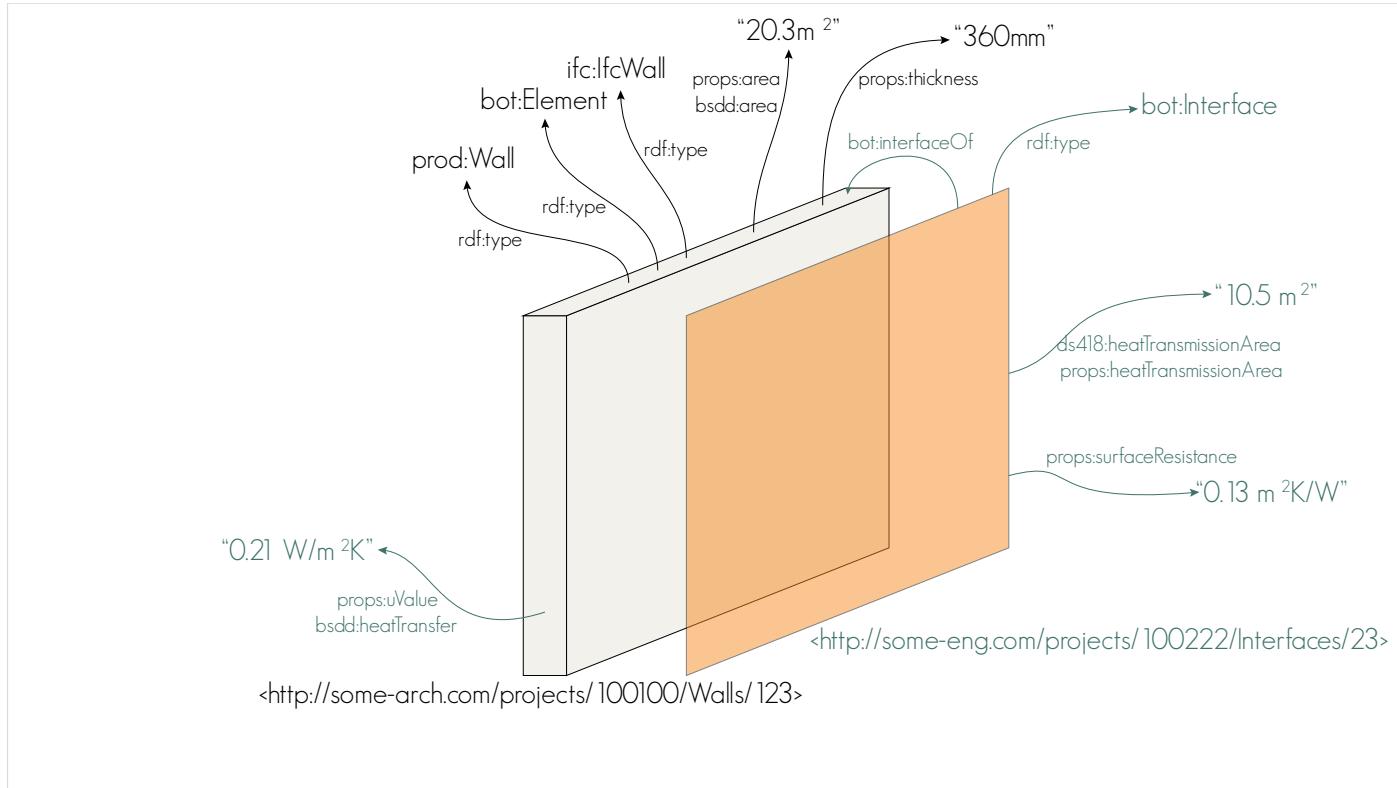
"Exchange of BIM-data as files makes data integration
impossible"

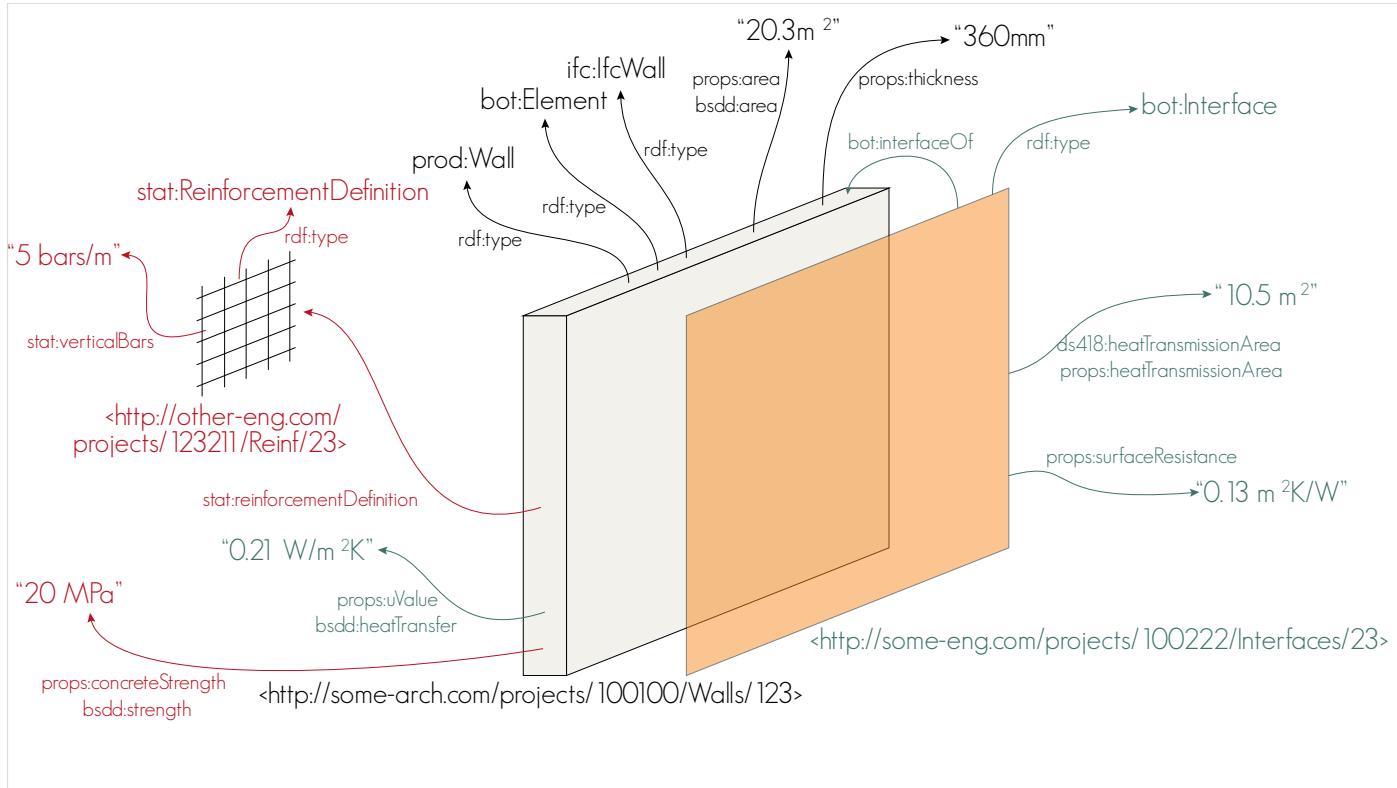




"We need to move from Today's monolithic nature of BIM
to a network based one"

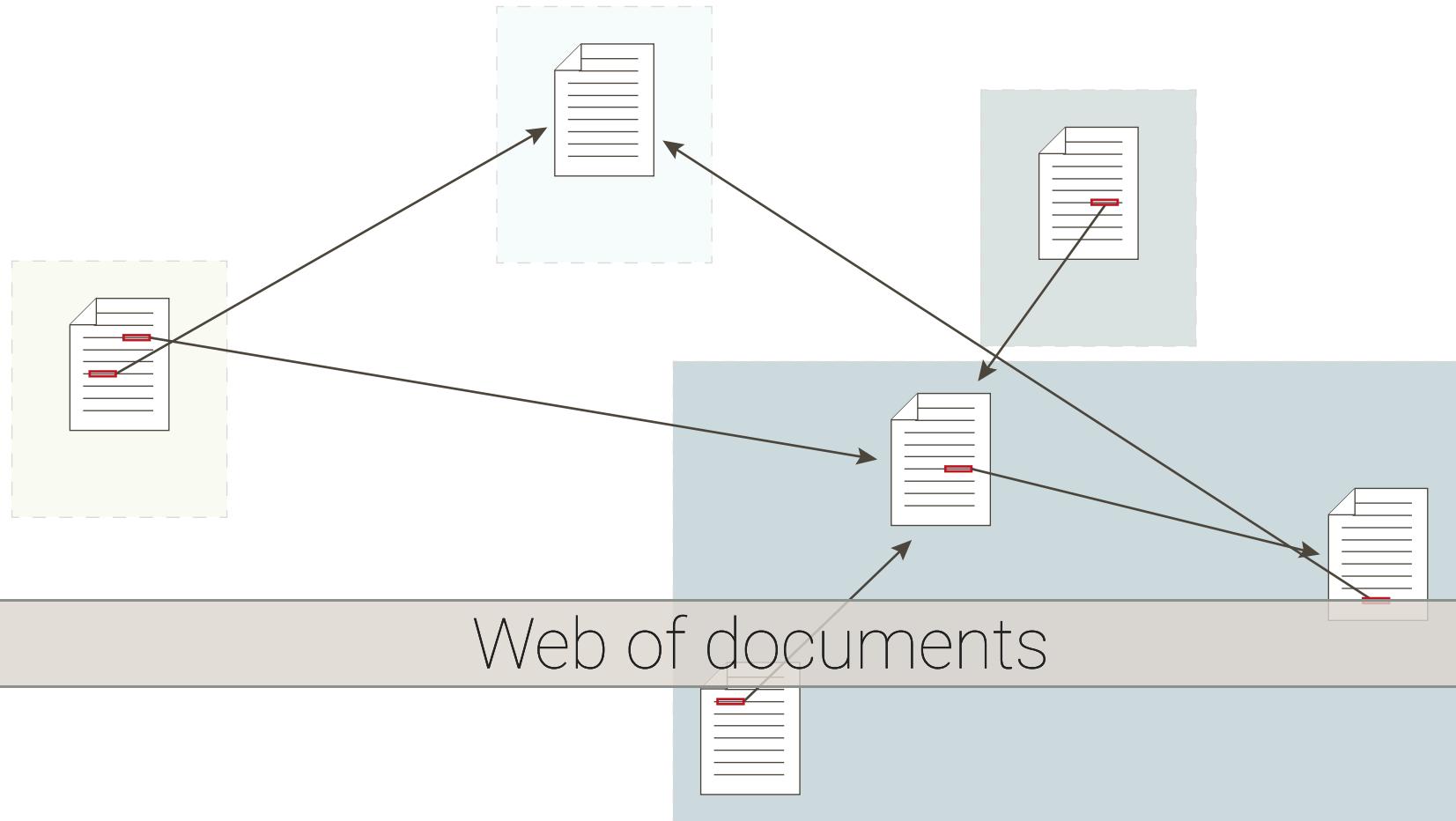


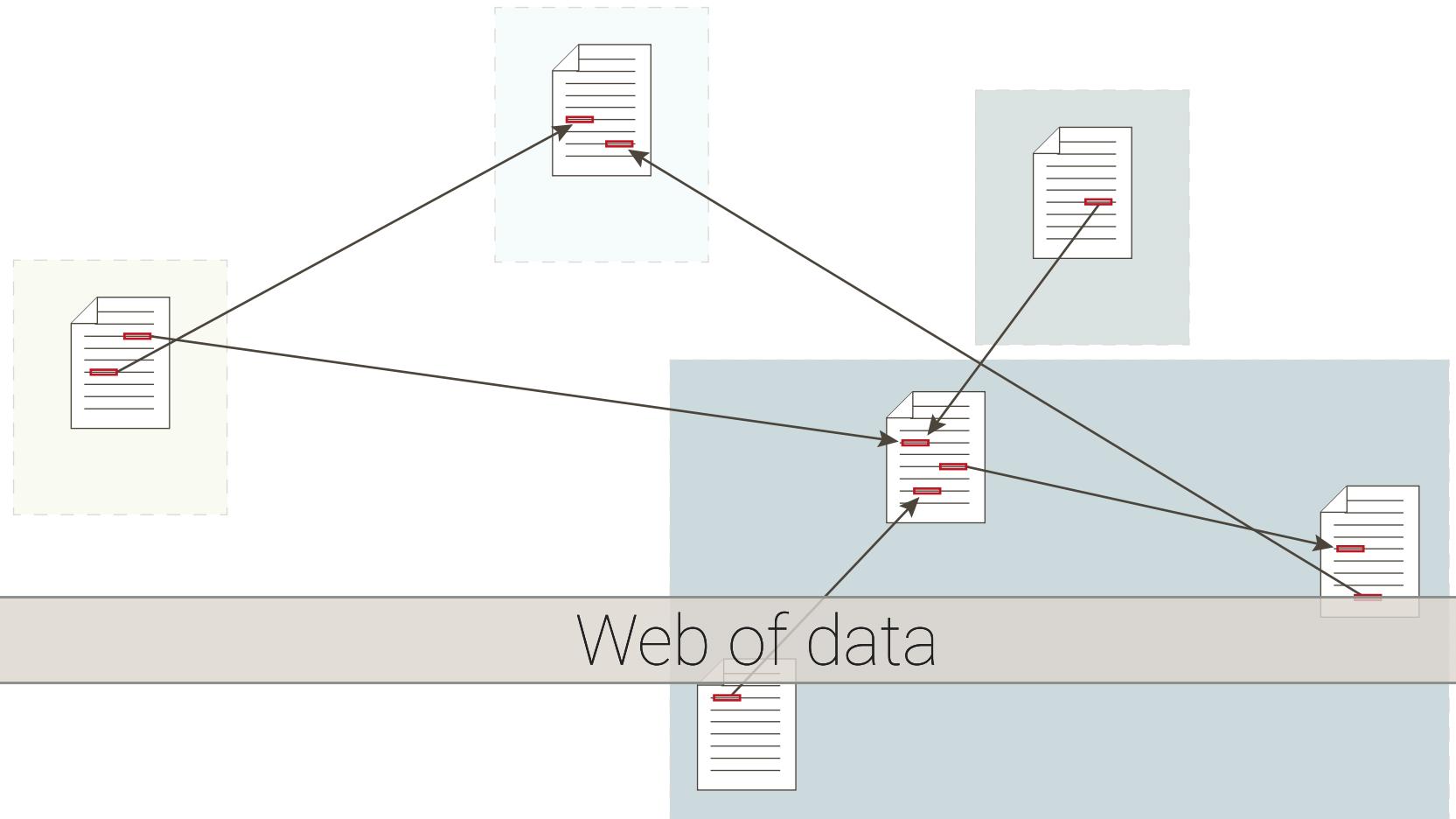




So how do we do this?

The idea is to use the existing infrastructure of the World Wide Web to mediate a distributed, network-based BIM





Data is stored and hosted by the stakeholder who generated it and is responsible for it

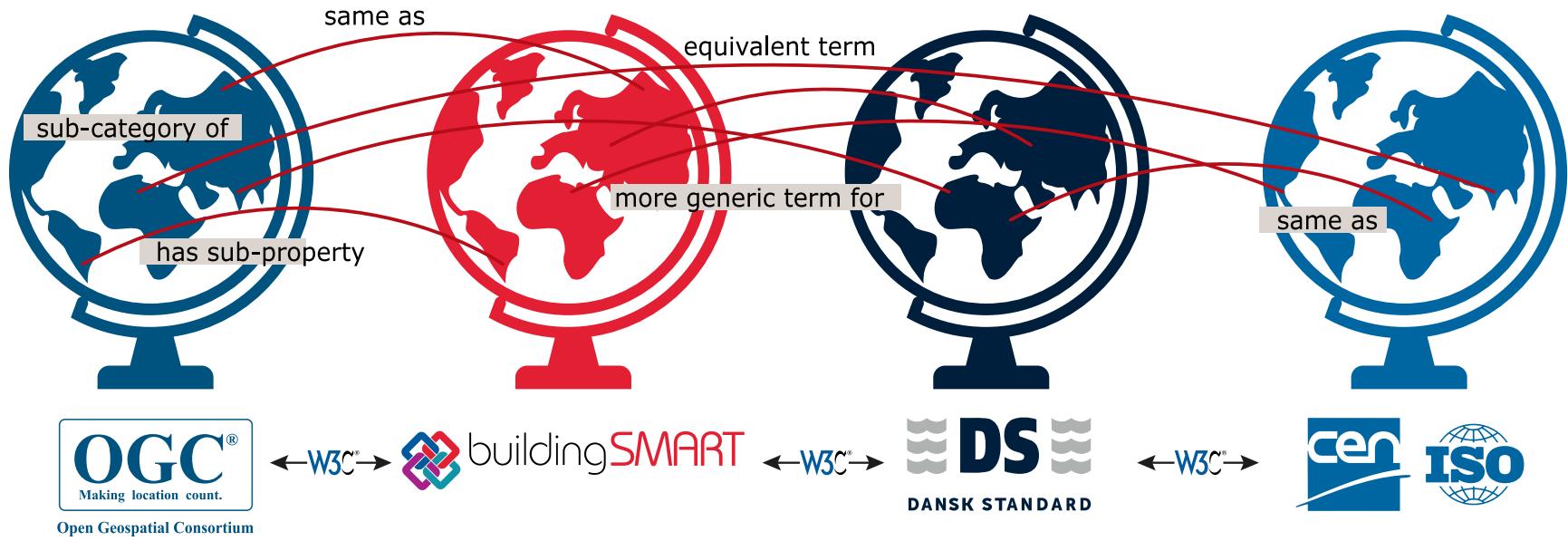
Data can be shared with authenticated people or be made publicly available

The model data can be extended with Linked Open Data
(products, material properties, IoT, GIS)

Even the schemas are distributed, and can therefore extend one another



Current situation: Open standards in isolated closed worlds



Linked data benefit: Standards use, extend and refer to one another

The technical details

Linked Data principles

1. Use URIs as names for things
2. Use HTTP URIs so that people can look up those names
3. When someone looks up a URI, provide useful information, using the standards (RDF, SPARQL)
4. Include links to other URIs. so that they can discover more things

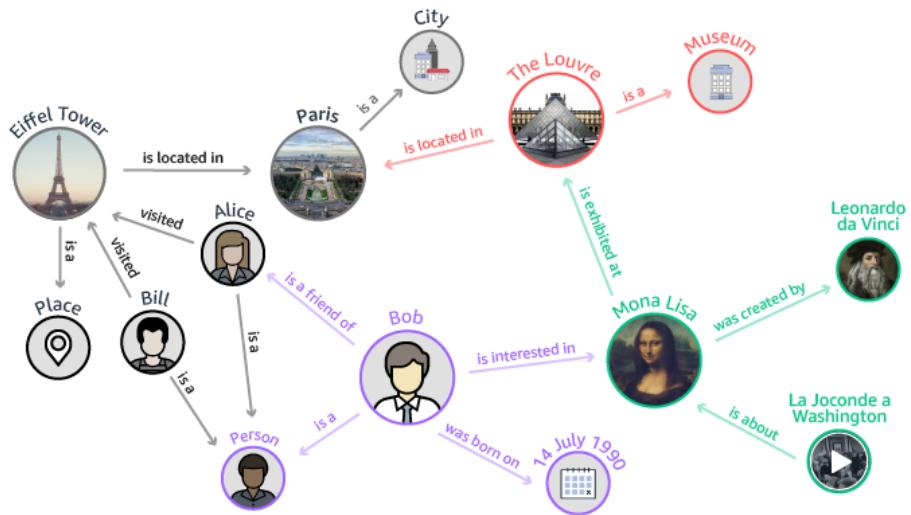
(The semantic web but not necessarily with reasoning and description logics)

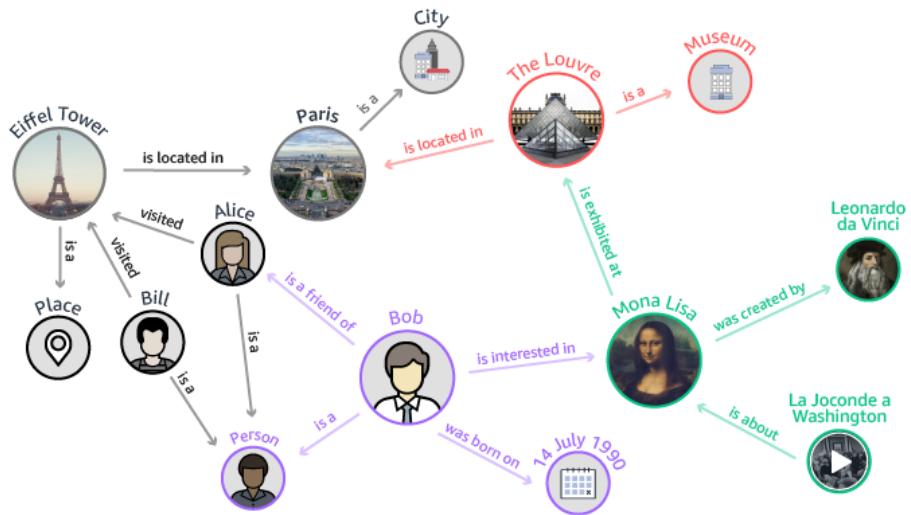


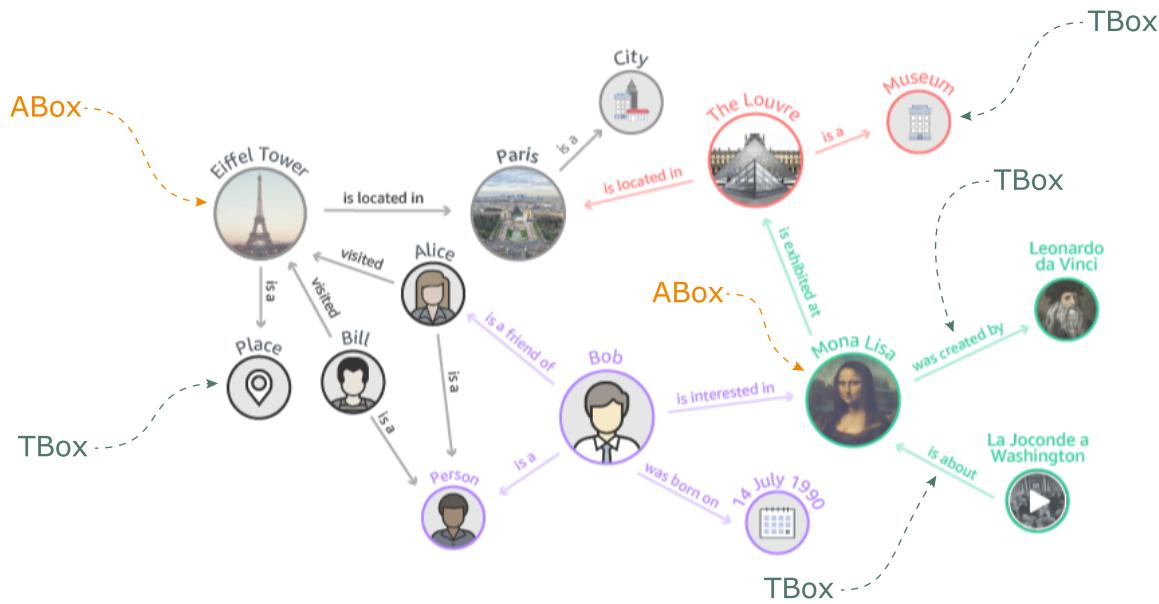
RDF: Resource Description Framework

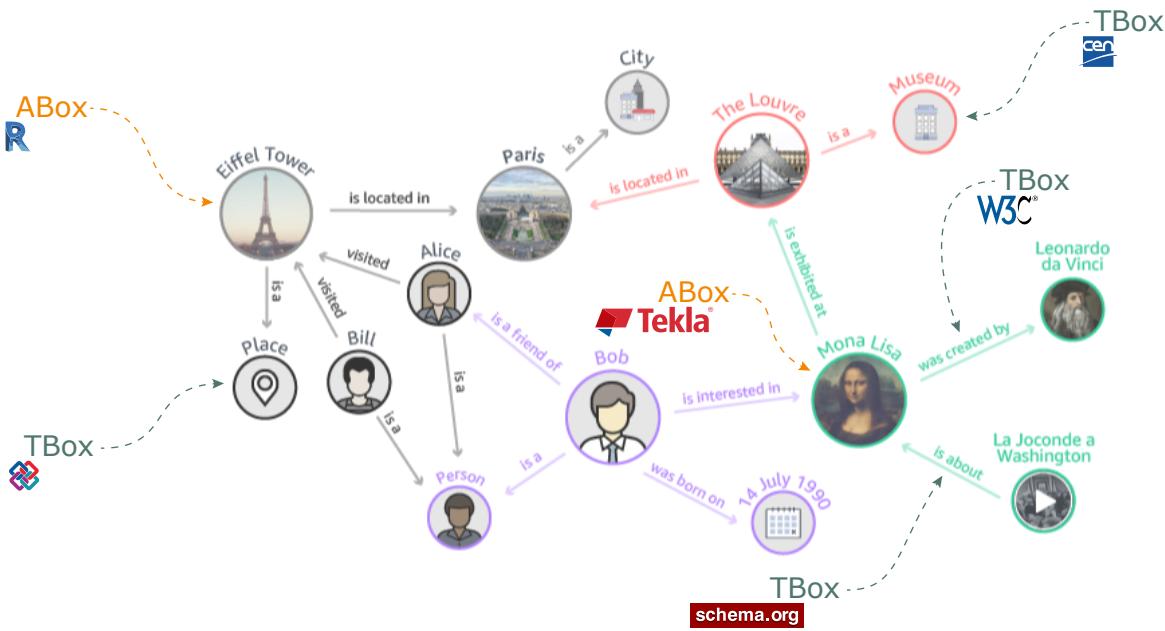












```
# CLASSIFICATION
<Eiffel_Tower> <is_a> <Place> .
<Paris>_<is_a> <City> .
<Bill> <is_a> <Person> .
<Alice> <is_a> <Person> .
<Bob> <is_a> <Person> .
<The_Louvre> <is_a> <Museum> .
```

These are not HTTP URIs

```
# CLASSIFICATION
<Eiffel_Tower> <is_a> <Place> .
<Paris>_<is_a> <City> .
<Bill> <is_a> <Person> .
<Alice> <is_a> <Person> .
<Bob> <is_a> <Person> .
<The_Louvre> <is_a> <Museum> .
```



```
<https://my-awesome-knowledge-graph.org/resources/Eiffel_Tower>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Paris>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Bill>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Alice>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Bob>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/The_Louvre>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
```

```
<https://my-awesome-knowledge-graph.org/resources/Eiffel_Tower>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Paris>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Bill>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Alice>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/Bob>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
<https://my-awesome-knowledge-graph.org/resources/The_Louvre>
  <http://www.w3.org/1999/02/22-rdf-syntax-ns#type> <http://schema.or
```



```
@prefix inst: <https://my-awesome-knowledge-graph.org/resources/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix schema: <http://schema.org/> .

inst:Eiffel_Tower    rdf:type      schema:Place .
inst:Paris           rdf:type      schema:City .
inst:Bill            rdf:type      schema:Person .
inst:Alice           rdf:type      schema:Person .
inst:Bob             rdf:type      schema:Person .
inst:The_Louvre      rdf:type      schema:Museum .
```

Relationships also need to have URLs

```
@prefix inst: <https://my-awesome-knowledge-graph.org/resources/> .  
@prefix xx: <https://my-awesome-knowledge-graph.org/ontology/xx#>  
  
# RELATIONSHIPS  
inst:Eiffel_Tower xx:is_located_in inst:Paris .  
inst:Alice xx:visited inst:Eiffel_T  
inst:Bill xx:visited inst:Eiffel_T  
inst:Bob xx:is_a_friend_of inst:Person .  
inst:Bob xx:is_interested_in "14 July 1990"  
inst:Bob xx:was_born_on ints:The_Louvre  
inst:Mona_Lisa xx:is_exhibited_at ints:Leonardo_da_Vinci  
ints:Mona_Lisa xx:was_created_by ints:Mona_Lisa  
ints:La_Joconde_a_Washington xx:is_about ints:Mona_Lisa
```

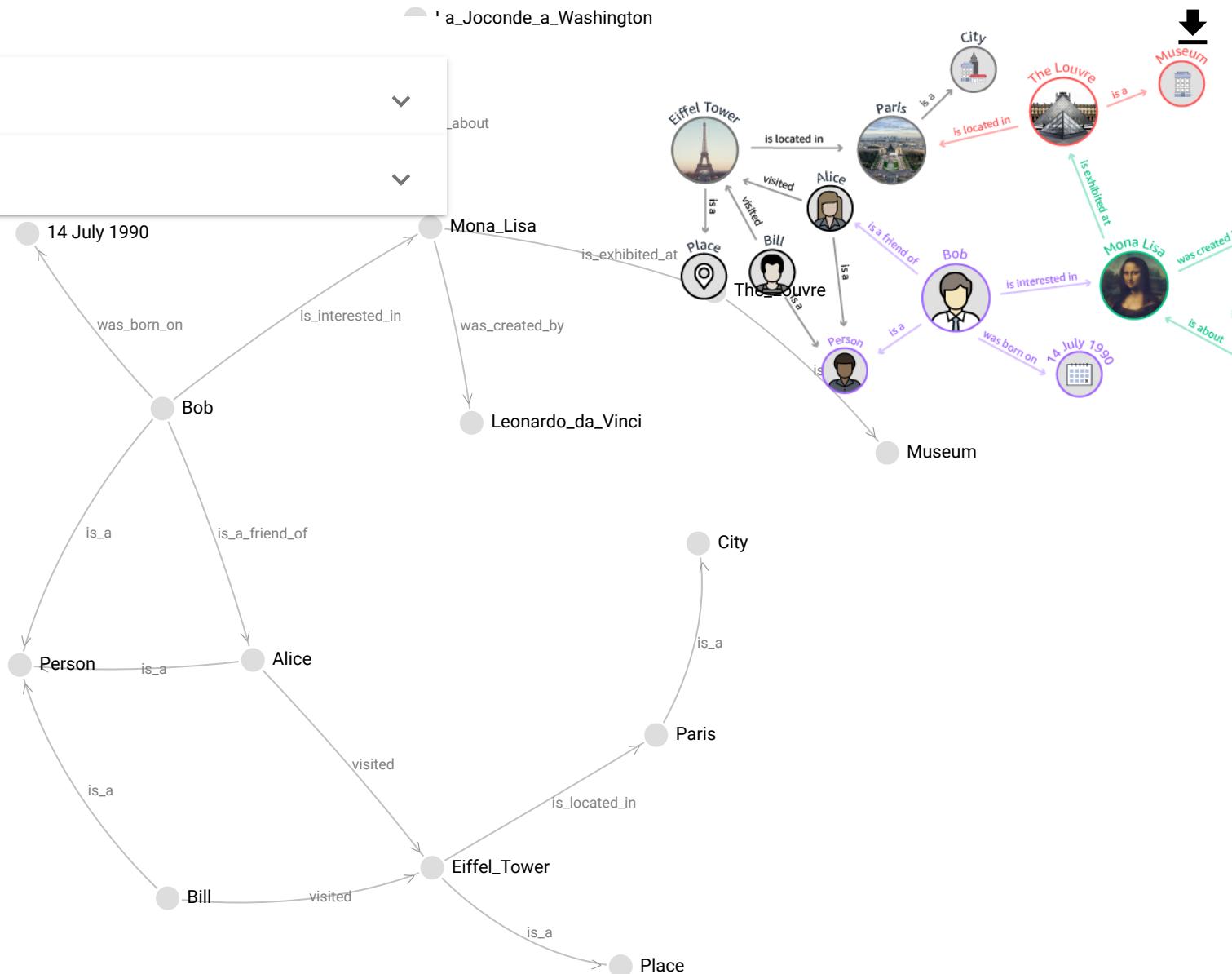


SPARQL: SPARQL Protocol and RDF Query Language

(Yes, the acronym is transitive - pretty annoying!)

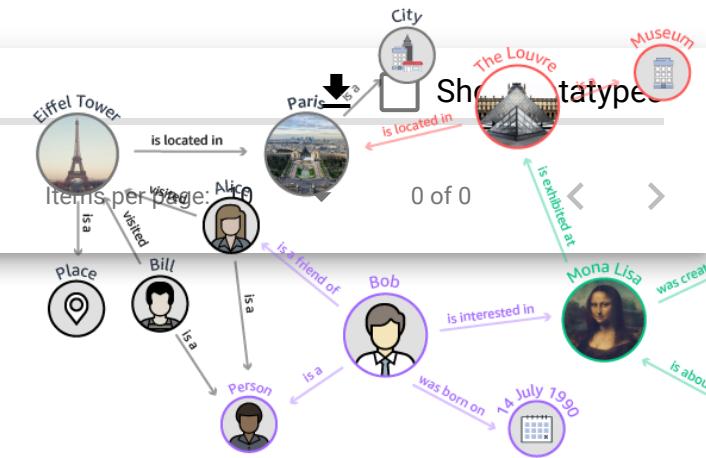
Triples

Query



Triples

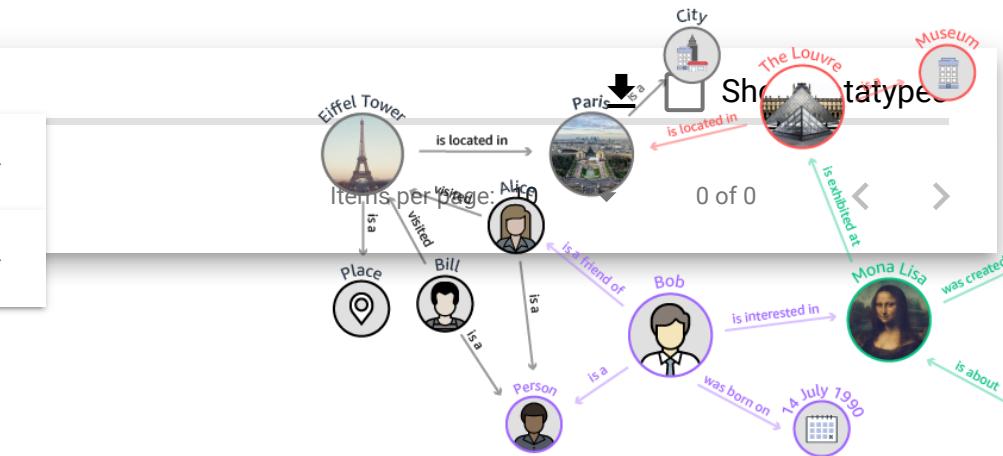
Query



Return all triples in the graph

Triples

Query



Return people who visited the Eiffel Tower

My contributions to the community

COMMUNITY & BUSINESS GROUPS



Participants

Aaron Costin Individual CLA commitment but affiliated with University of Florida	Al-Haam Hamdan Individual CLA commitment but affiliated with Technische Universität Dresden	Alberto Giretti Università Politecnica delle Marche	Alberto Pavan Politecnico di Milano - ABC Department	Colin Meerwald Tecno	Dario Bonino Individual CLA commitment but affiliated with Istituto Superiore Mario Boella	David Butcher ETH Zurich	Deeptha Sundaram Building Research Establishment	Jeroen Werbrouck Vicoslab	Jia-hen Tee Vicoslab	Joel Bender Individual CLA commitment but affiliated with Cornell University	Jonas Bülow Schneider Electric	Maria Saorin Fundación CIC	Masaki Minami Individual CLA commitment but affiliated with Accella, inc.	Mateusz Beyrowski KU Leuven	Mathias Bonduel Imperial College London	Prathap Valluru Individual CLA commitment but affiliated with Universit��s Technische Universität Dresden	Ranjith K Soman Imperial College London	Ra��l Garc��a Castro Universidad Politecnica de Madrid	Ricardo Tomasi Istituto Superior Mario Boella

W3C BERG FERDINAND SCHNEIDER Linked Building Data (LBD) Community Group



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Trinity College Dublin

MADS HOLSTEN RASMUSSEN



JEAN-PIERRE LEFRAN  OIS
Universit   de Lyon



RUI DE KLERK MOTA

Individual CLA commitment but affiliated with Universidade de Lisboa

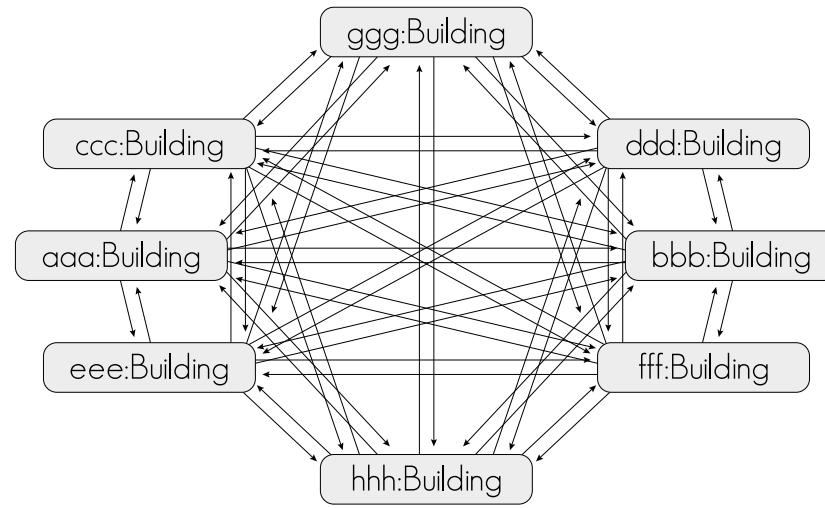
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119 members March 2020

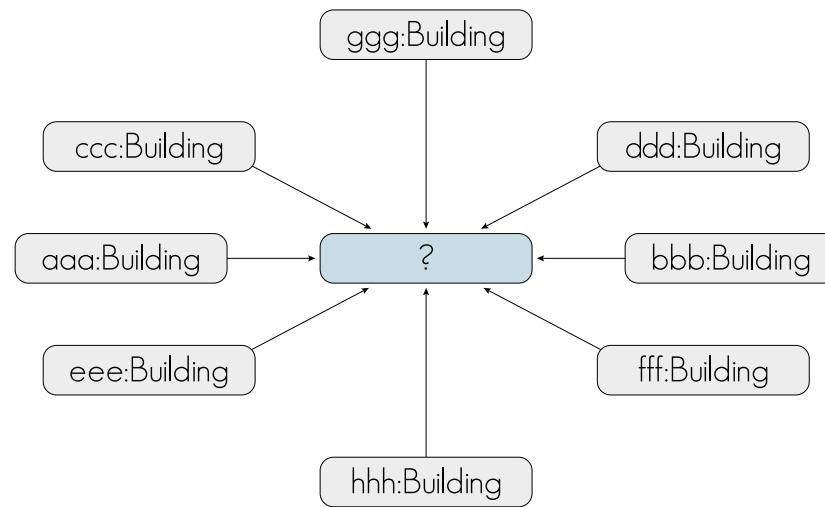
Ivan van Leeuwen relate.nl	Benjamin Di Martino Individual CLA commitment but affiliated with Universitat Polit��cnica de Catalunya (UPC)	Bilal Sucar Change Agents ABC	Bjorn Butzen Individual CLA commitment but affiliated with University of Antwerp	Fangzheng Lin Individual CLA commitment but affiliated with Technische Universität Dresden	Francesco Arosio Individual CLA commitment but affiliated with University of Antwerp	Francisco Ferns-Sanso Individual CLA commitment but affiliated with University of Aveiro	Francisco Regateiro Individual CLA commitment but affiliated with University of Lisbon, Department of Civil Engineering, Architecture and Environmental Engineering	Kiril Toneyev KTH Royal Institute of Technology	Kyle Shipp THO	Kyriakos Katsigarakis Technological University of Crete	Laura Daniele THO	Mr Stacey Aalto University	Nam Vu Hoang Aalto University	Nicolas BUS CITE	Tarciso Mendes de Fariaz University of Aut��nia - Sill Swiss Institute of Biomedicine	Ted Guild W3C	Thomas Krijnen Eindhoven University of Technology	Tomas Polach Archigic

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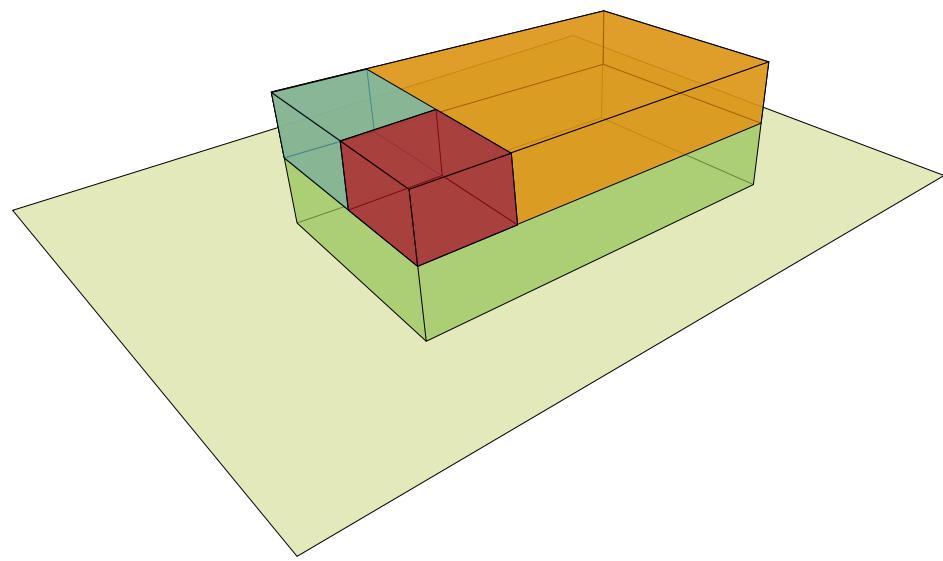
Christophe BURDET AMERICA	Christopher Nienke Universit�� de Paris/CNRS	Claudio Murelli Polytechnique Montr��al - ARC Department	Clayton Miller Individual CLA commitment but affiliated with Swiss Federal Institute of Technology Zurich	Hendro Wicaksono Individual CLA commitment but affiliated with Karlsruhe Institute of Technology	Herv��e Pruvost Fraunhofer Gesellschaft	Jan Voskuil Tecno	Jason Koh University of California, San Diego	mark wood Individual CLA commitment but affiliated with Arup	Martin Naumann Archigic	Martynas Jusevi��us Linked Data, USA	Maria Poveda Villal��n Universidad Politecnica de Madrid	Pierre Coupet Virtual Organization Management Institute	Pim van den Helm Raumhofer Gesellschaft	Pit Stenzel Individual CLA commitment but affiliated with String	Pouya Zangeneh University of Tehran	Walter Terkaj CNA-ISTI Istituto di Scienze e Tecnologie dell'Informazione "A. Faedo"	Wendelin Springer Individual CLA commitment but affiliated with String	Yongwook Jeong Sejong University

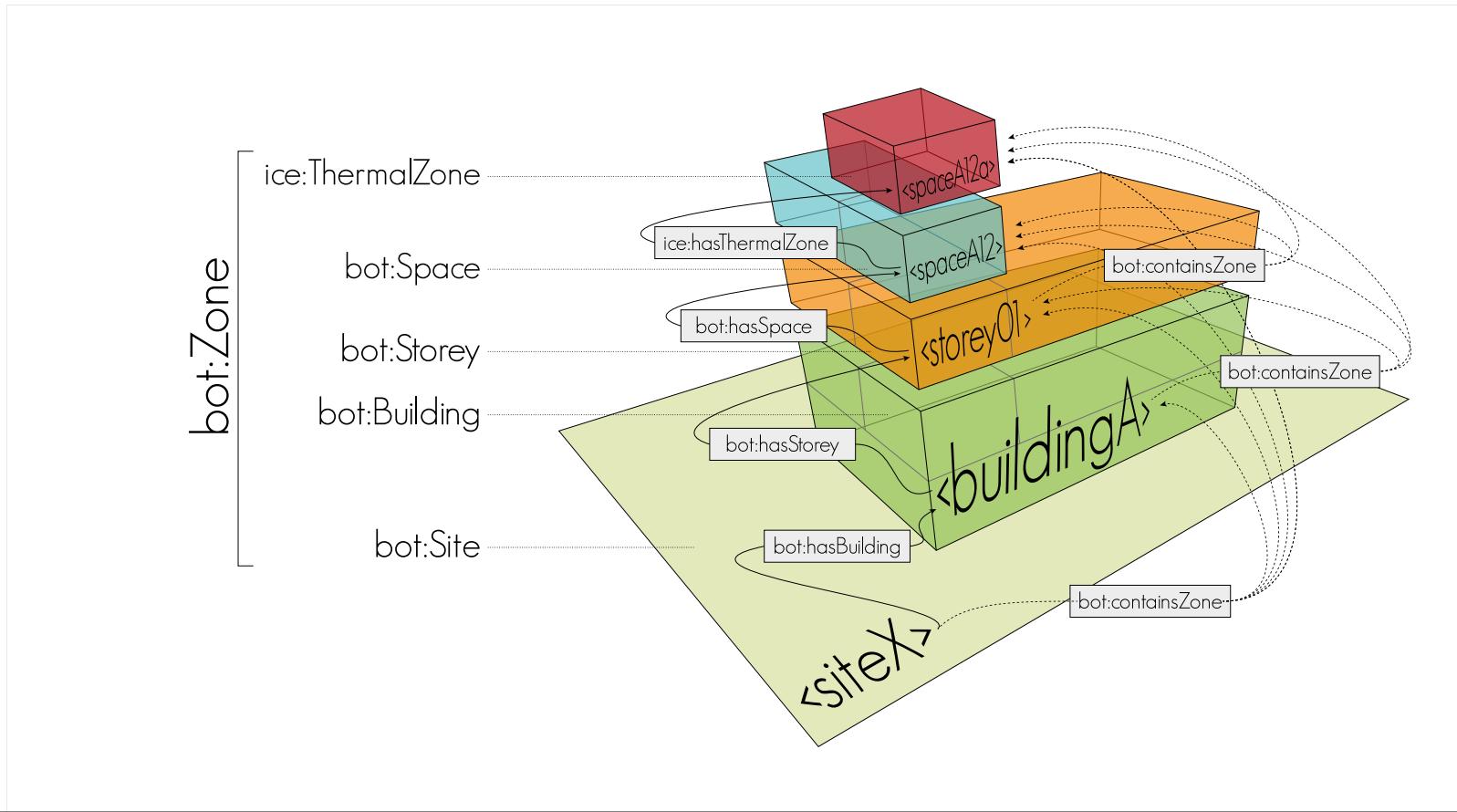




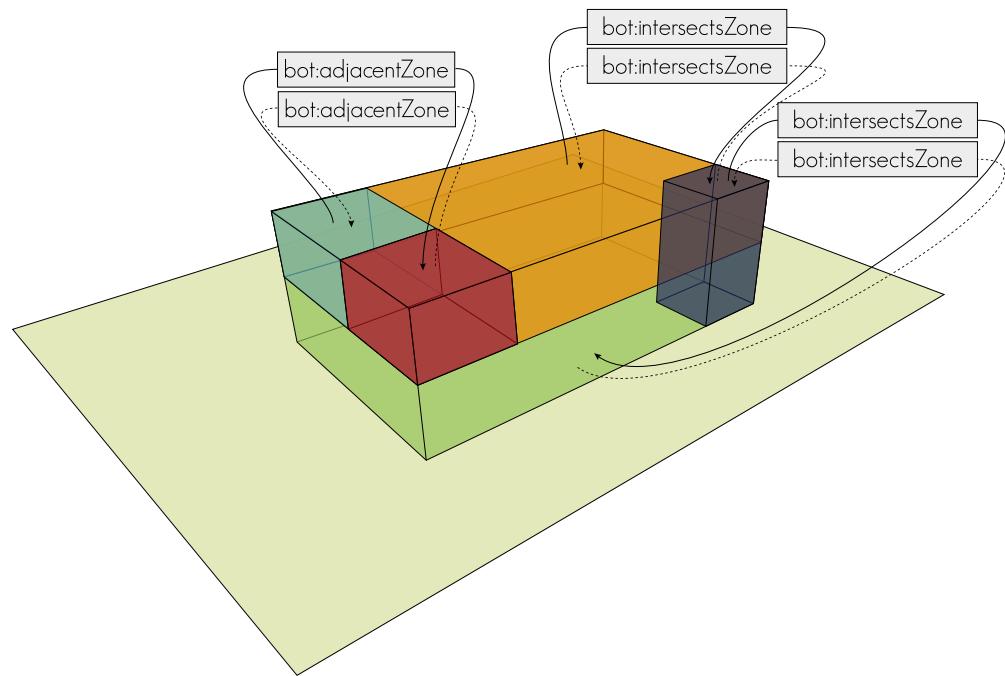


bot:Zone



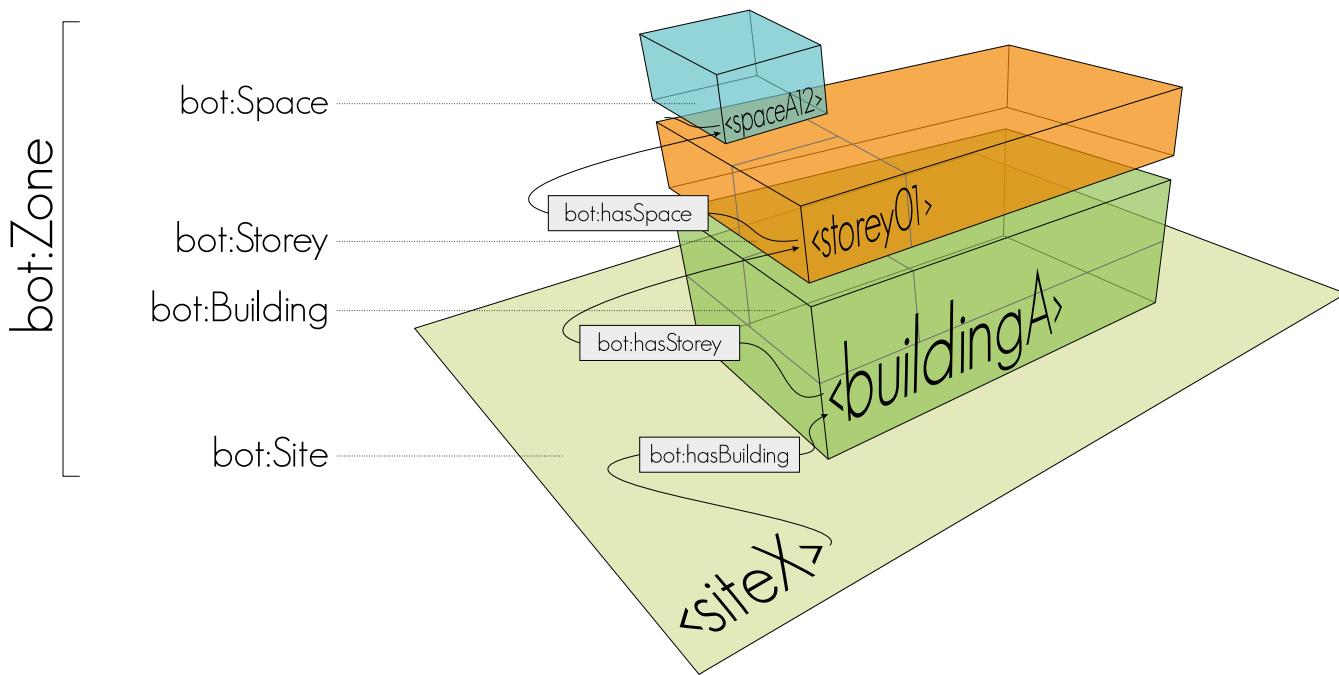


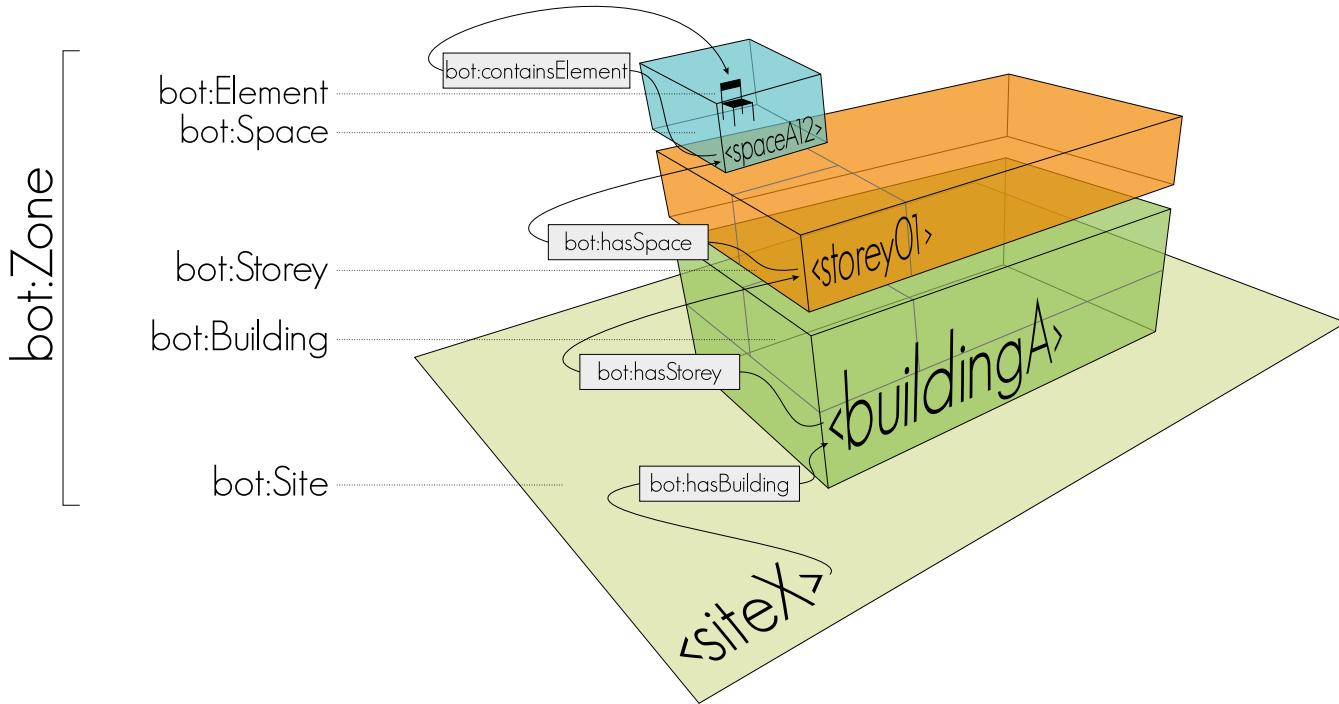
Dashed arrows = implicit knowledge inferred by reasoning

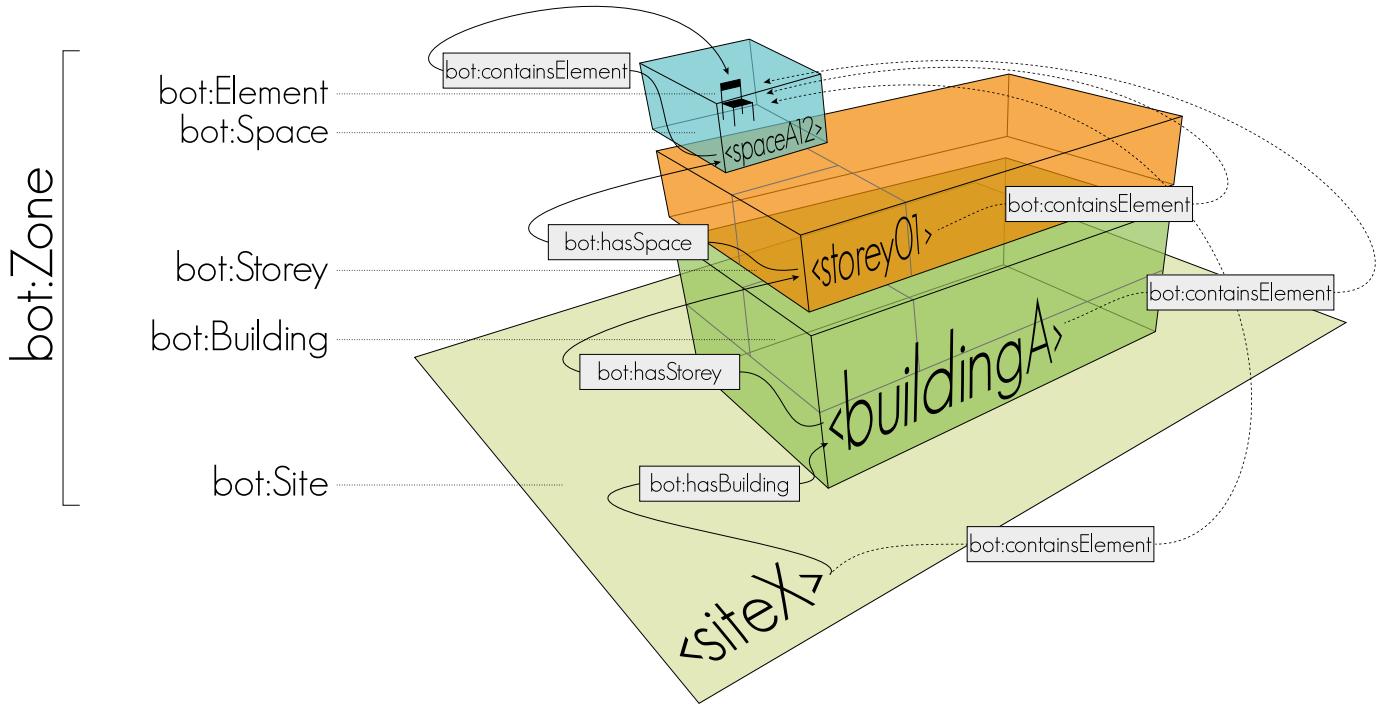


Dashed arrows = implicit knowledge inferred by reasoning

bot:Element

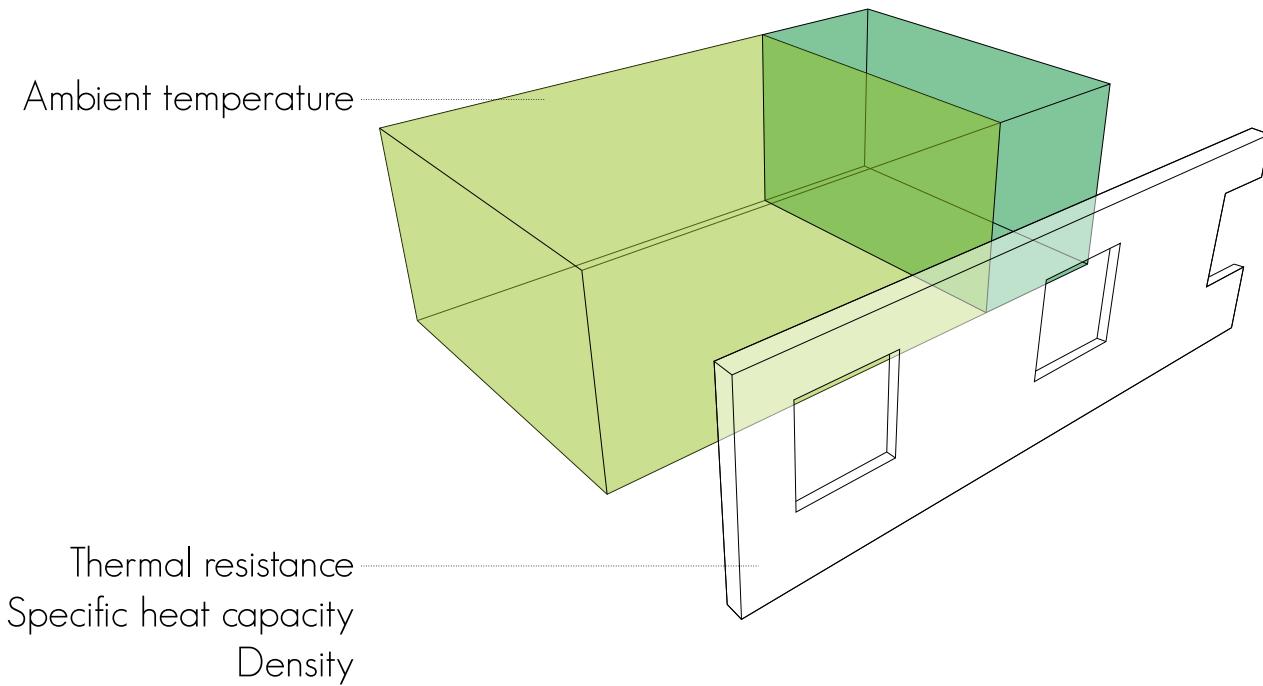


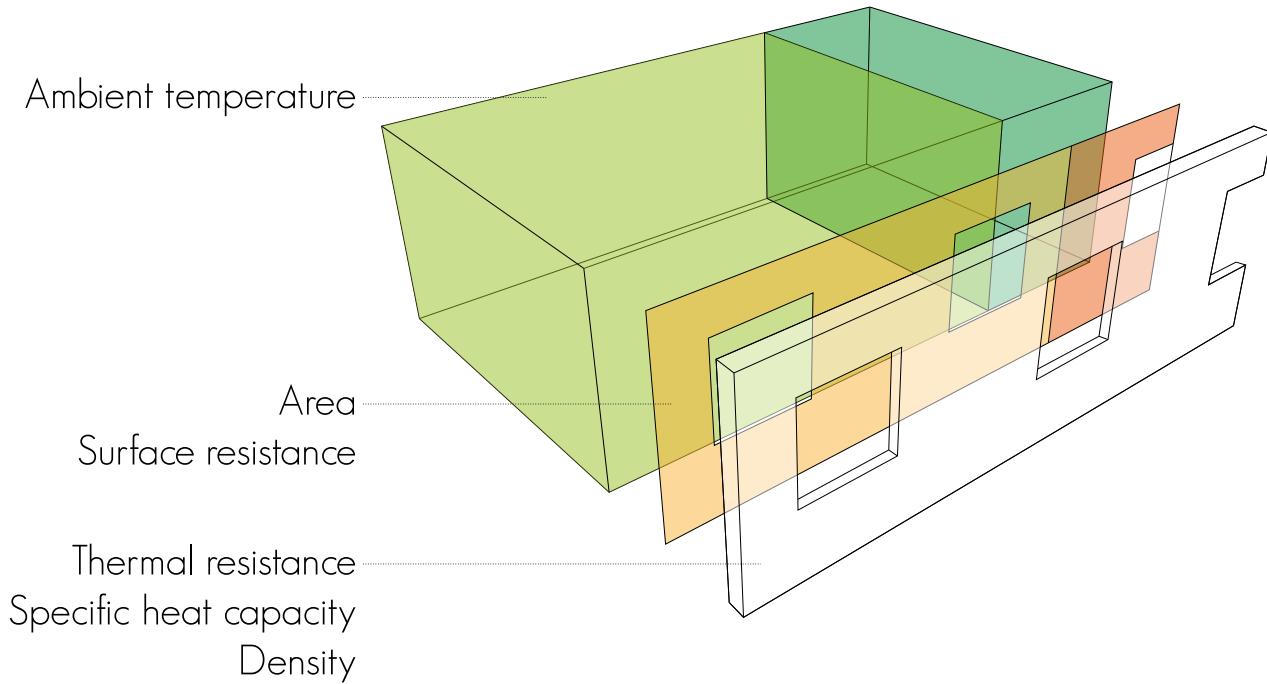


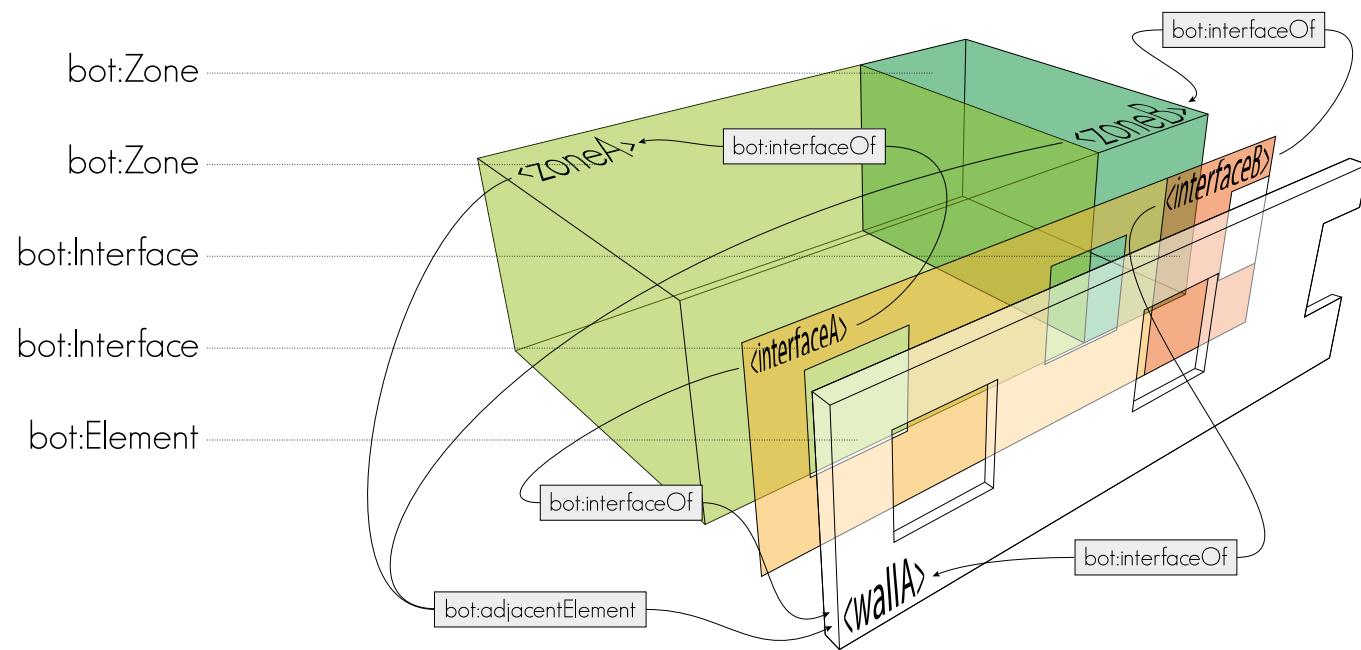


Dashed arrows = implicit knowledge inferred by reasoning

bot:Interface







OPM: The Ontology for Property Management

Proceedings of the 9th Linked Data in Architecture and Construction Workshop

OPM: An ontology for describing properties that evolve over time

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² KU Leuven, Dept. of Civil Engineering, Technology Cluster Construction, Ghent, Belgium

Abstract. The W3C Linked Building Data, on the Web community group discusses different potential patterns to associate values to properties of building elements. In this paper, we are interested in enabling a different value association method for reuse and other purposes: the ability to change in time, or to associate a value with some metadata such as a timestamp, version, and origin data. Existing ontologies in the Architecture, Engineering and Construction (AEC) domain, such as the Semantic Web Ontology for the Smart Energy-Vehicle System (SEAS) ontology, are at a static point. Next, we set up a competency query to represent associations between metadata and values. We illustrate the use of OPM with several scenarios where a value associated with a building element changes over time, and how it can be used to support decision making in the AEC domain.

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Managing interrelated project information in AEC Knowledge Graphs

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ARTICLE INFO

Keywords: Interrelated data, Building information modeling, Design stage, Ontology, Information exchange, Semantic web graph, Semantic web

ABSTRACT

In the architecture, engineering and construction (AEC) industry stakeholders from different companies and backgrounds collaborate in raising a common goal being a new physical structure. The exact goal is typically not known from the beginning, and throughout all design stages, new decisions are made - similarly to other design domains [1]. In this paper, we propose the design stage as a starting point. With changing stakeholder requirements, the design stage must be highly related and amenable to changes. We introduce a complex network of documents, requirements and product specifications as primarily captured in static documents. We propose a knowledge graph to represent this complex network. The main motivation of this work is to further propose Data-Driven Project Management (DDPM) [2]. The main contribution of this work is to propose a knowledge graph to support decision making. The proposed knowledge graph is based on the SEAS ontology [3] and the OPM ontology [4]. The proposed knowledge graph is based on the SEAS ontology [3] and the OPM ontology [4].

1. Introduction

The architecture, engineering and construction (AEC) industry is a fragmented industry, with organisations spread between numerous, often competing, building architects, engineers, contractors, subcontractors, owners, and so forth. This is one of the reasons why Bitterle [5] describes it as a complex system. All these stakeholders have different roles and responsibilities in digital environments. With the advent of Building Information Modeling (BIM) tools, these varying levels of proficiency have become more apparent. They are often

documented online with an asset holding Knowledge Graph. The particular design task evaluated is performing heat loss calculations for spaces of a future building using an AECX described using Semantic and project specific extensions of the Building Topology Ontology (BTO) in combination with OPM. With this work, we demonstrate the feasibility of using OPM to support decision making in a complex environment, thereby providing the engineers with insights to support decision making as changes occur. The application uses a strict division between the client viewer and the actual data model holding design logic, and can easily be extended to support other design tasks.

2. Related work

referred to as levels of maturity or levels of BIM adoption in the industry, and there exist frameworks for quantifying these [5,6].

3. Document exchange at the heart of AEC project design workflows

Wicht [5] describes that construction project teams can, in essence, be considered as information processing systems. The defined components why an information exchange between project teams is essential - an observation that is also backed up in various analyses of the construction industry [1,6,7]. The situation in the

Other approaches to OPM are OPM as a vocabulary. Or properties attached to a sub-group (and possibly other domains) as the assignment of properties to any feature of interest (FD) - in this particular case, building-related elements.

Using OPM as a vocabulary is useful when designing a building. The semantic nature entails that information which is valid at one point in time might no longer be valid in the future, and keeping an overview of information validity here is important. This is especially true when the information is shared among many people in a predominantly manual manner by tracking changes in meeting minutes, mail correspondence as a word can be the handle of the individual project participants. It creates a serious risk for conflicts in the design process [8].

Modeling design changes that occur over time is complex as we must define when some FD is valid and when it is not. This is a challenge that is not well solved in current OPM. A new FD is a particular issue, for instance, the same FD for the width of it has changed? Linked data provides us with the means to allow a concept defined by one party to be extended by another party. This is a common problem in the AEC domain as building items have interfaces to several different parties from different domains. The door might have a requirement for thermal capacity defined by one party, whereas another party has

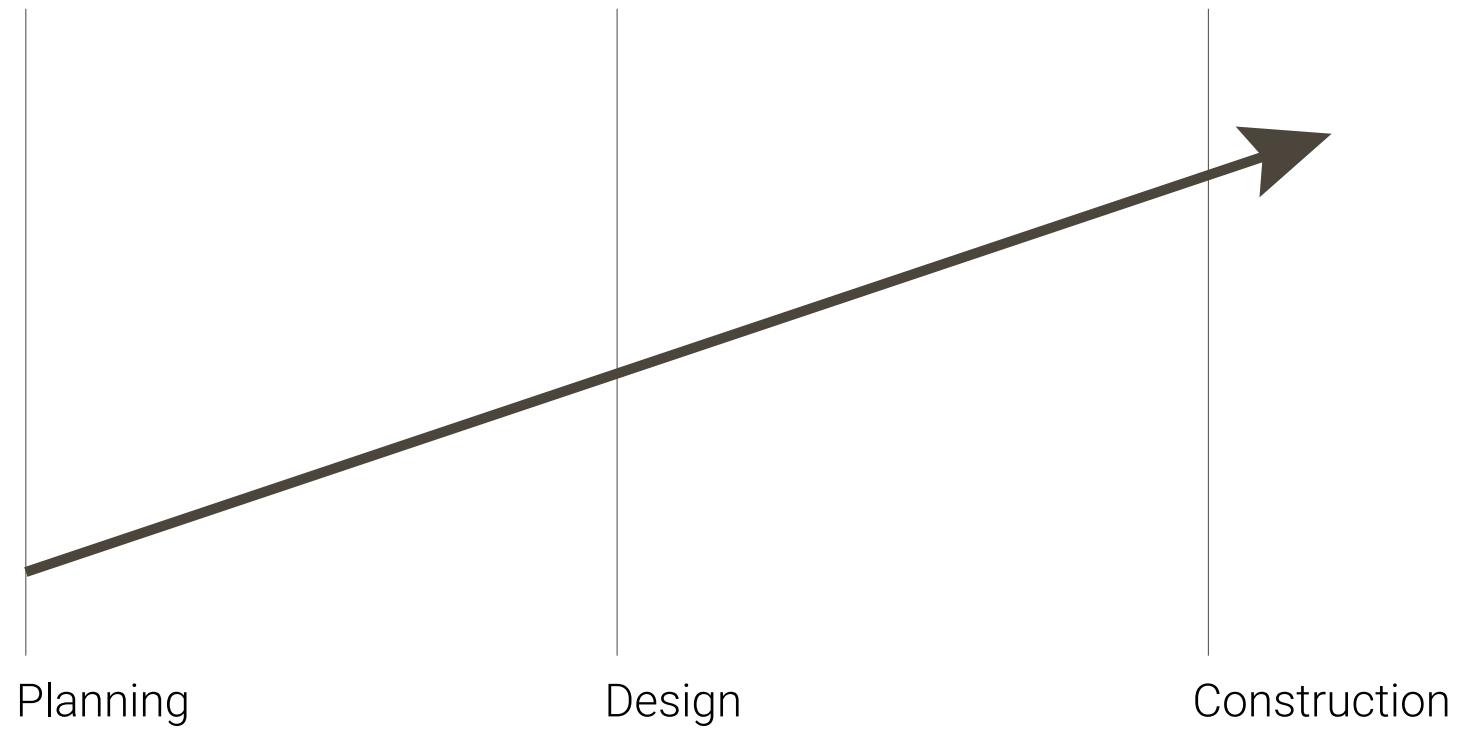
* Corresponding author.

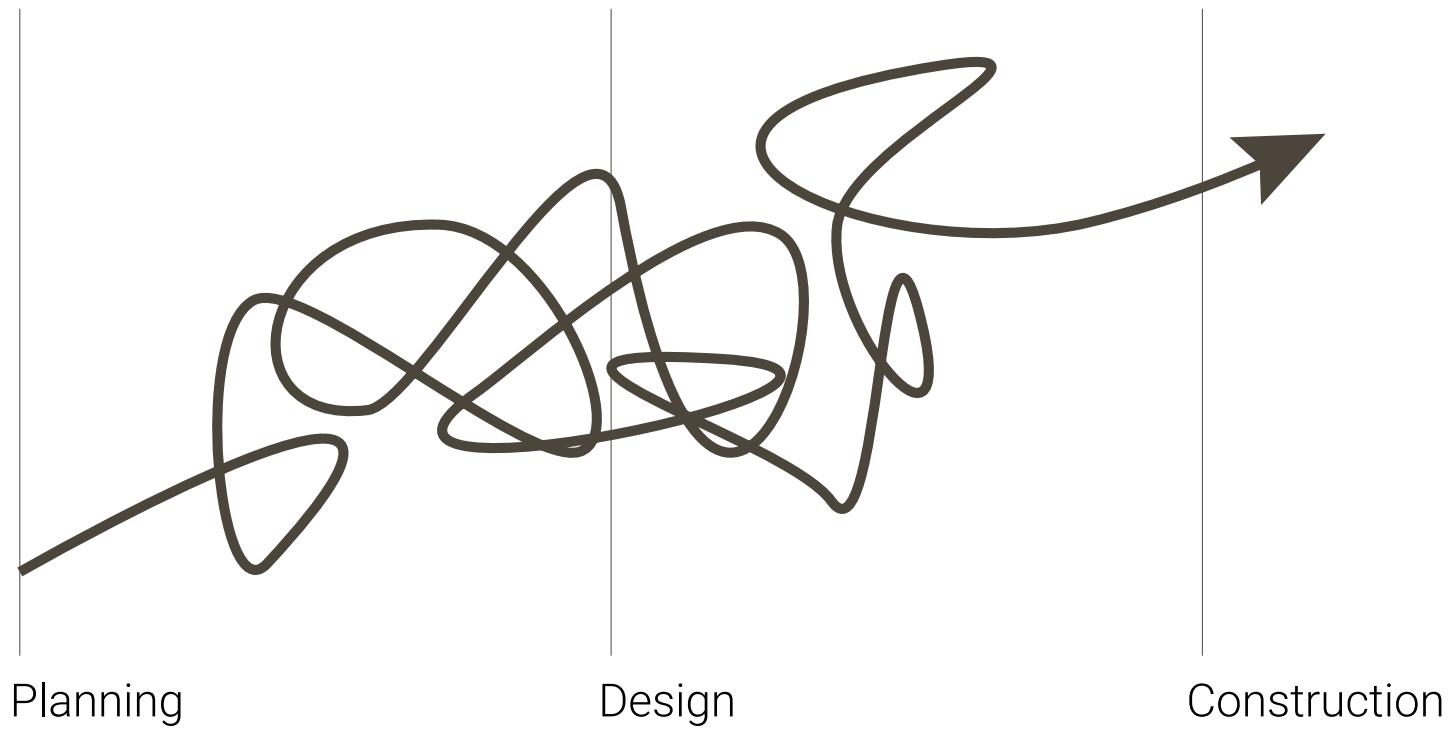
E-mail address: mholten@dtu.dk (M.H. Rasmussen).

<https://doi.org/10.1016/j.autcon.2019.102956>

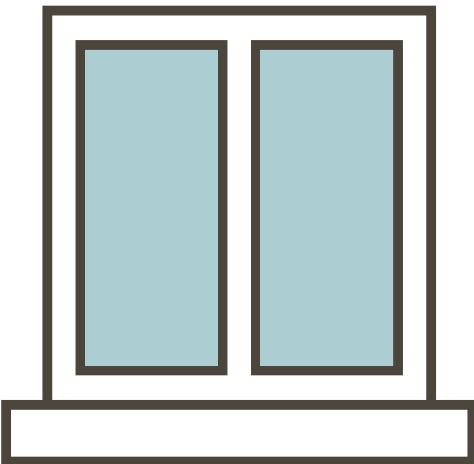
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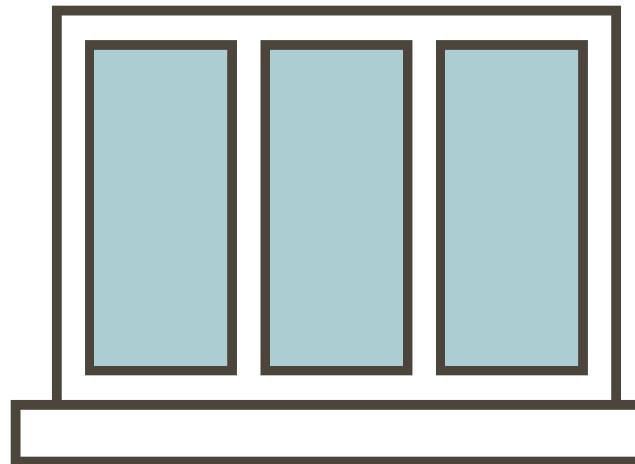




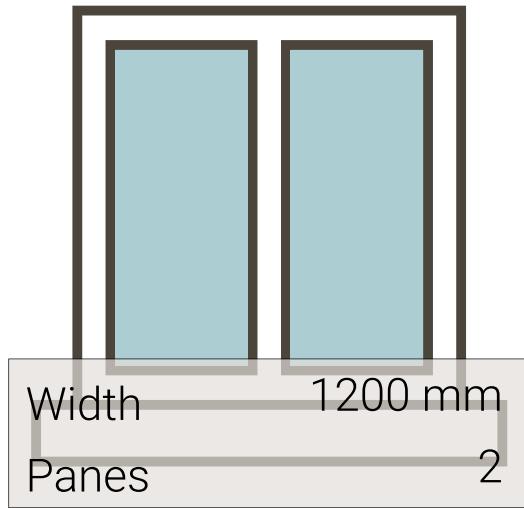
<Window-325>



Still <Window-325>???

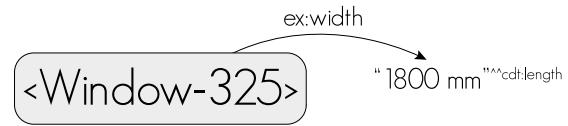


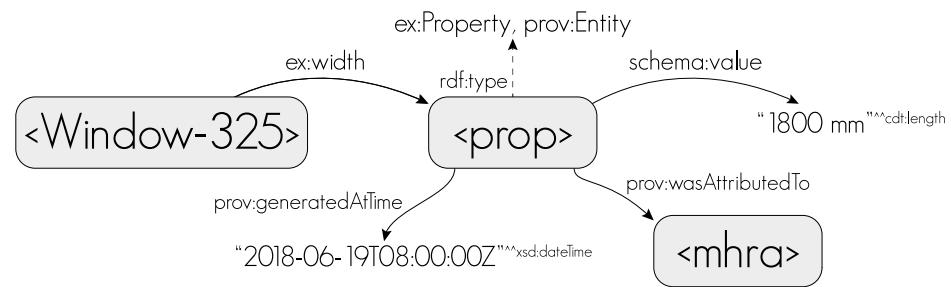
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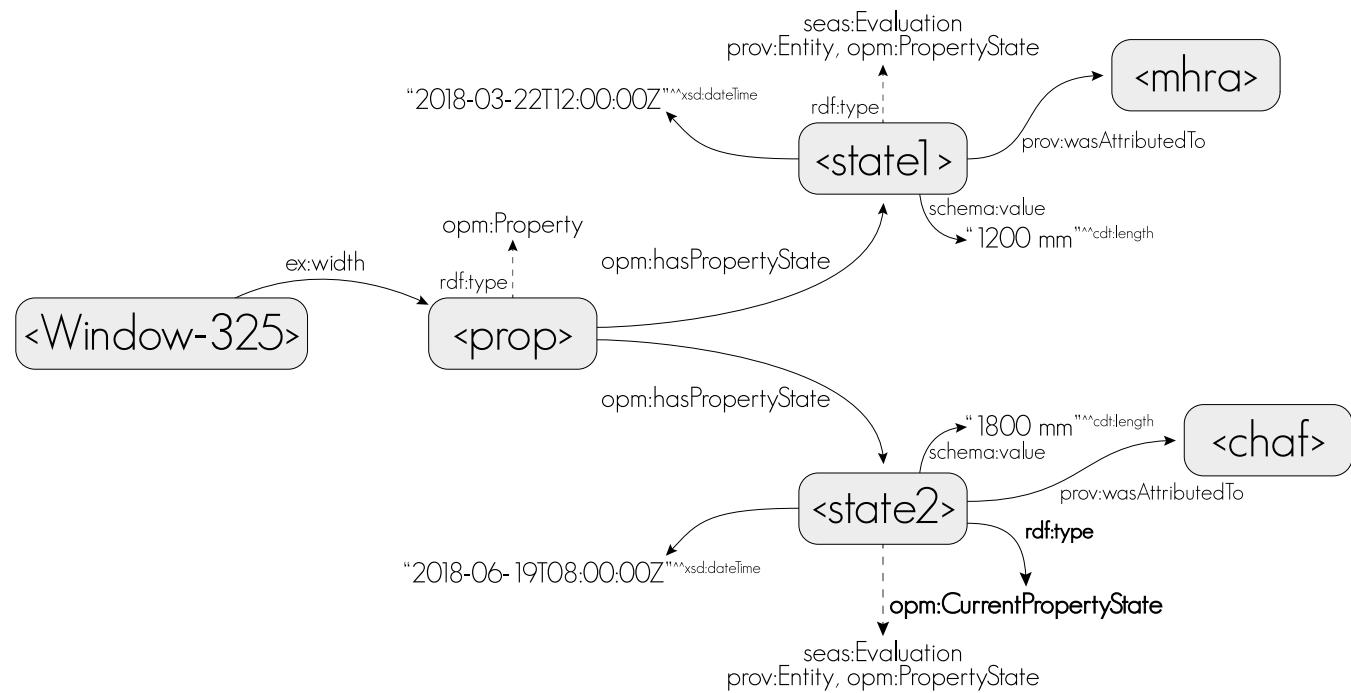


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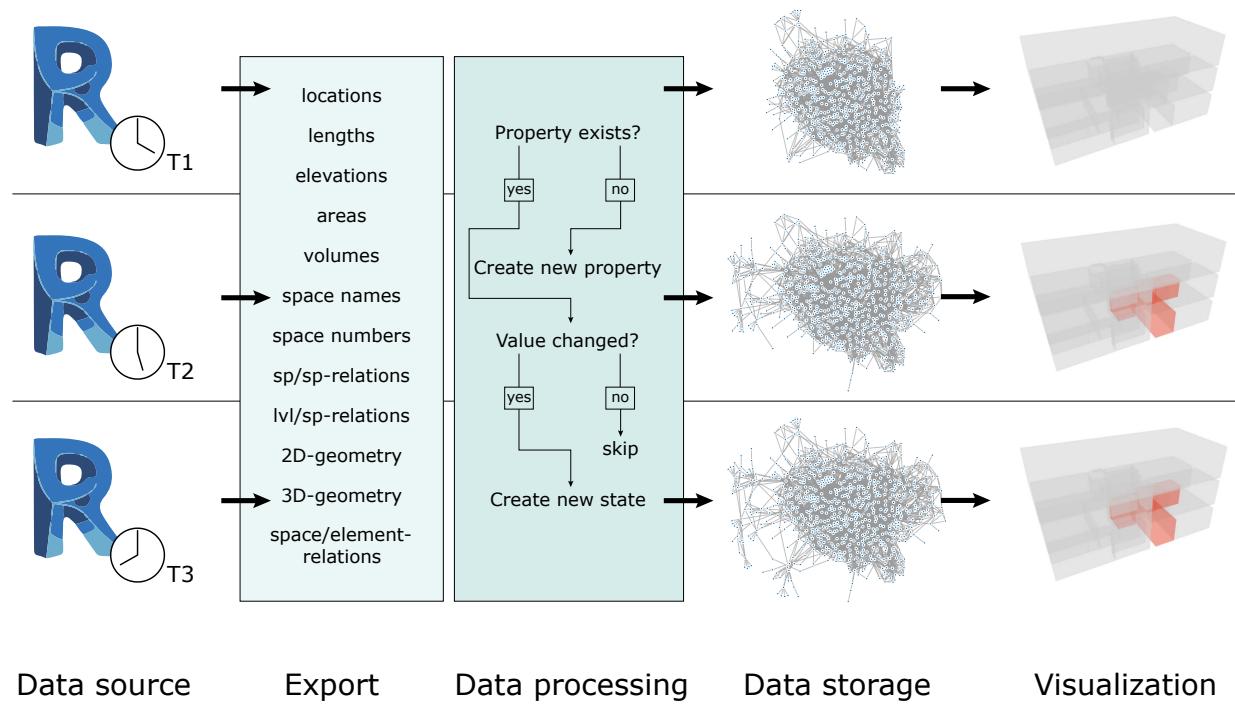




States also be classified for reliability. Is it an
assumption or a **confirmed value**?

A **derived property state** can be related to the particular state of another property from which it was derived

If a derived property state refers to a state that is no longer the current property state, the derived property state becomes **outdated**



A case study

BOT + SSN/SOSA

CEDR-WG.org/vol-2213/paper-4-1

Demo: Integrating Building Information Modeling and Sensor Observations using Semantic Web

Mads Holten Rasmussen¹, Christian Askev Frausing¹,
Christian Anker Hvidt¹, and Jan Karlsøej¹

Technical University of Denmark, Kgs. Lyngby, Denmark
mhcar@byg.dtu.dk

Abstract. The W3C Linked Building Data on the Web community group is studying modeling approaches for the built environment using semantic web technologies. One outcome of this effort is a set of proposed ontologies together providing a necessary terminology for the Architecture, Engineering, Construction and Operations (AECO) domain. In this paper we present an integration between different datasets described using these ontologies in combination with the standard ontology for representing Sensors, Observations, Sampling, Actuation, and Sensor Observations (SSN/SOSA). In combination, the datasets provide the building-level topology, a plan for the placement of sensors and actuator locations and a log of their observations. We further suggest an integrated design approach that enables the designers to explicitly express the semantics of the sensors and actuators from the early stages of the project such that they can be used for optimization and operation.

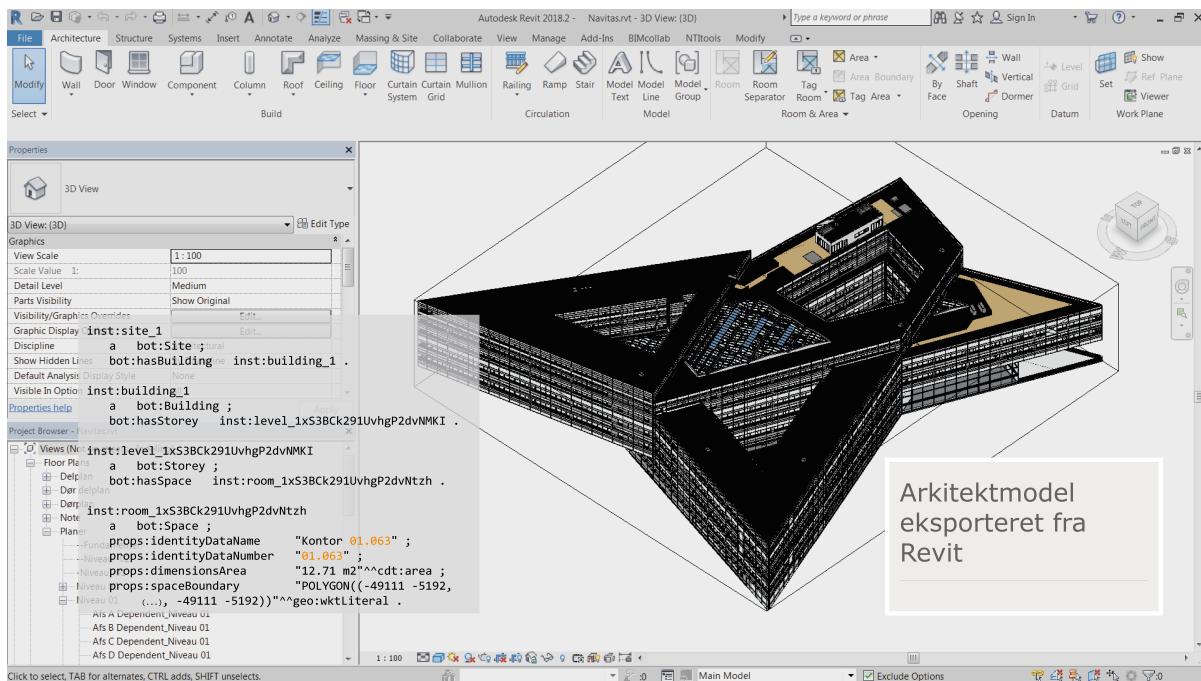
1 Introduction

The AECO industry involves many stakeholders. It is a distributed environment that assumes and manipulates a shared, distributed project material on which they are all dependent. This data is continuously evolving such as the result influences different

phases (programming, design, construction, operation), it is often handed over to new project partners, and a large distributed organization is formed. The temporary organization is a challenge, and the dataset usually consists of printed files, file-printed documents and the like, the complexity grows. It is a well-established fact that every time the project material is handed over at stage changes data is lost [2].

Building Information Modeling (BIM) is a methodology aimed at minimizing information loss by using technologies to handle building data in a better way. The buildingSMART organization engaged in the development of industry standards to provide consensus in BIM implementations, and with the Industry Foundation Classes (IFC) schema [5] most terminology for describing a building is provided. However, where IFC is mainly aimed at file-based information exchanges, numerous research projects are focusing on how web technologies can support the dynamic nature of the projects by providing a data and information exchange [10]. The World Wide Web Consortium (W3C) Data and Data Communities Group (W3C D&D CG) engages domain experts in the development of ontologies and modeling approaches, thereby hopefully paving the way for a near-future semantic web-based BIM.

In this work, we present an implementation between three datasets (1) the architectural model described using the Building Topology Ontology (BOT) including simple



Navitas.xlsx - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Add-Ins eDocPrinter Acrobat Team ALECTIA

S1

NAVITAS FACILITY
Building Integration SYSTEM

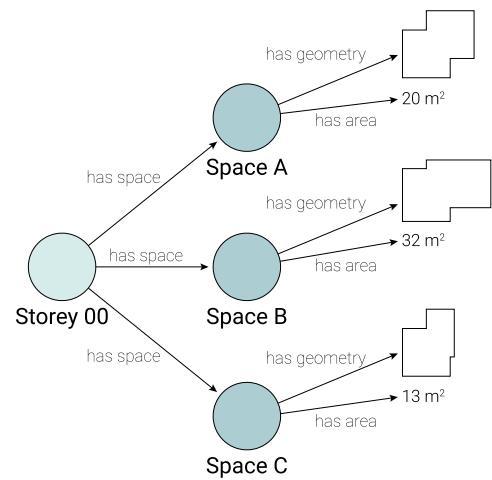
Hent data

Ønsket lokale: 01.063 - Lokalenummer som der ønskes data på (niveau.lokalenummer)
 Fra Dato.: 2018-03-09 - Data fra følgende dato (år-måned-dag)
 Til Dato.: 2018-03-15 - Data til følgende dato (år-måned-dag)

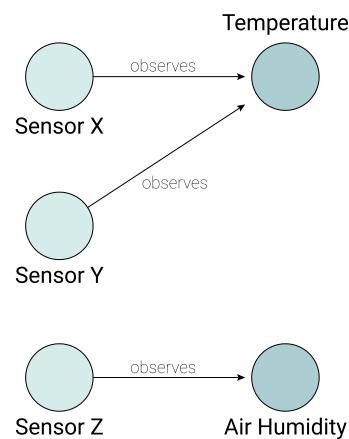
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9	09-03-18	00:47	OPVARMING	1500	425	21.4	22.5	22.0	0.0	1.0	22.0	19.0	100	10
10	09-03-18	01:18	OPVARMING	1500	425	21.8	22.5	22.0	0.0	1.0	22.0	19.0	100	10
11	09-03-18	01:48	OPVARMING	1500	425	22.1	22.5	22.0	0.0	1.0	22.0	19.0	90	10
12	09-03-18	02:18	OPVARMING	1500	425	22.3	22.5	22.0	0.0	1.0	22.0	19.0	80	10
13	09-03-18	02:48	OPVARMING	1500	425	22.4	22.5	22.0	0.0	1.0	22.0	19.0	50	10
14	09-03-18	03:18	OPVARMING	1500	425	22.2	22.5	22.0	0.0	1.0	22.0	19.0	20	10
15	09-03-18	03:48	OPVARMING	1500	425	21.7	22.5	22.0	0.0	1.0	22.0	19.0	40	10
16	09-03-18	04:18	OPVARMING	1500	425	21.4	22.5	22.0	0.0	1.0	22.0	19.0	90	10
17	09-03-18	04:48	OPVARMING	1500	425	21.7	22.5	22.0	0.0	1.0	22.0	19.0	100	10
18	09-03-18	05:17	OPVARMING	1500	425	21.9	22.5	22.0	0.0	1.0	22.0	19.0	100	10
19	09-03-18	05:48	OPVARMING	1500	425	22.2	22.5	22.0	0.0	1.0	22.0	19.0	90	10
20	09-03-18	06:18	OPVARMING	1500	425	22.4	22.5	22.0	0.0	1.0	22.0	19.0	70	10
21	09-03-18	06:48	OPVARMING	1500	425	22.3	22.5	22.0	0.0	1.0	22.0	19.0	100	10
22	09-03-18	07:20	OPVARMING	1500	425	22.0	22.5	23.0	0.0	1.0	22.0	19.0	100	10
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24			inst:room_01.063-Temp-Sensor-obs#		425	22.0	23.5	23.0	0.0	1.0				
25			a_sosa:Observation ;		1500	425	22.4	24.0	23.0	0.0	1.0			
26			sosa:hasFeatureOfInterest		inst:room_1x53BCk291UvhgP2dvNtzh;		23.0	23.0	0.0	1.0				
27			sosa:hasResult		inst:room_1x53BCk291UvhgP2dvNtzh;		20.7 Cel	20.7 Cel	cdt:temperature					
28			sosa:madeBySensor		inst:room_01.063-Temp-Sensor		24.0	23.0	0.0	1.0				
29			sosa:observedProperty		inst:room_01.063-Temp		23.0	23.0	0.0	1.0				
30			sosa:resultTime		"2017-04-18T05:11:32+01:00"	xsd:dateTime .	23.0	23.0	0.0	1.0				
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RAPPORT Data

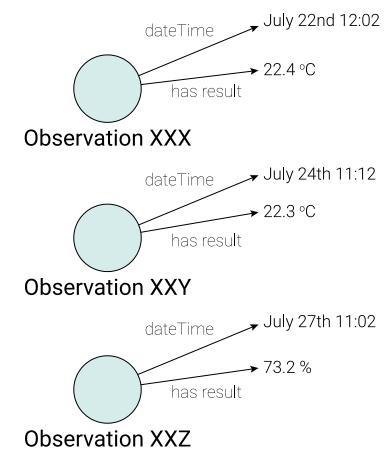
Sensorobservationer udtrukket fra spreadsheets



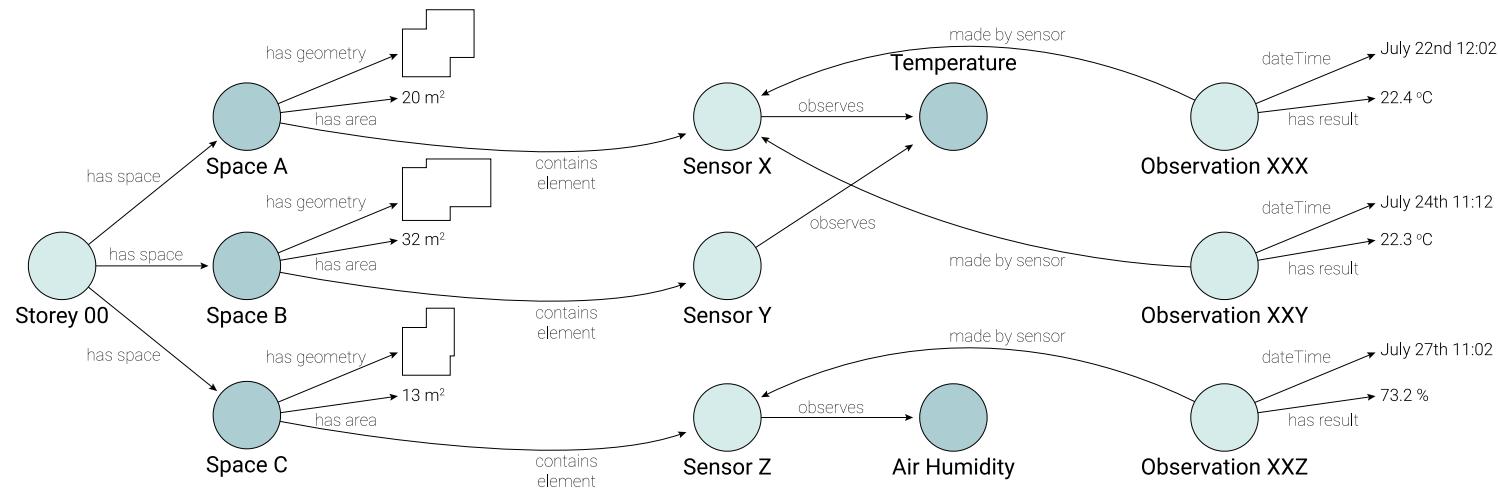
Building topology



Sensors



Observations



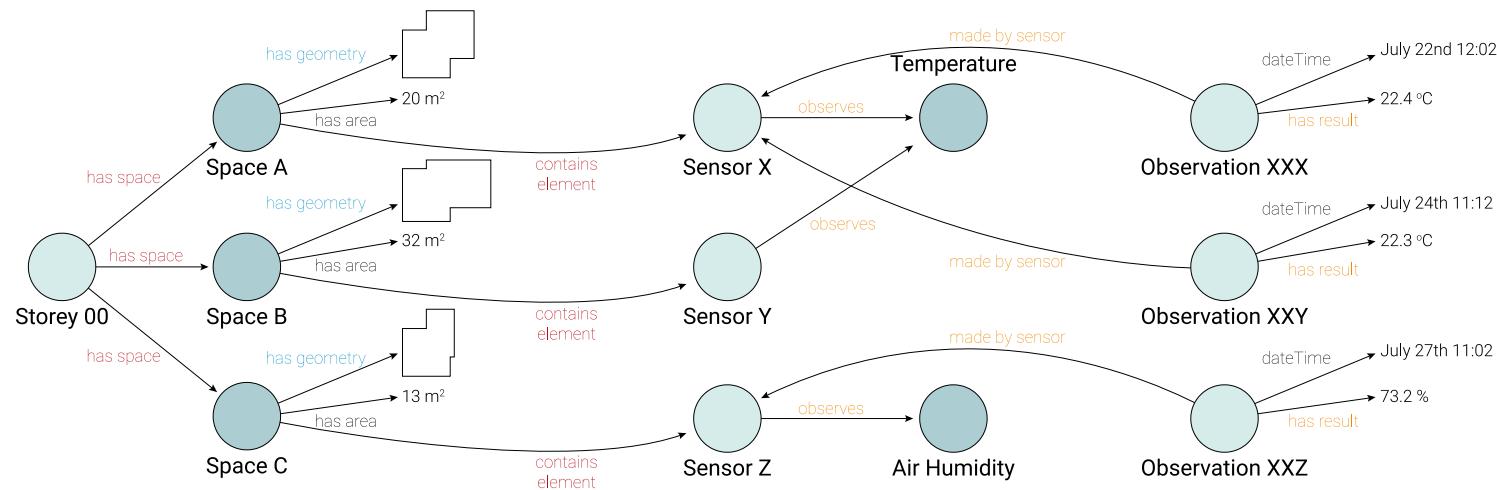
Building topology

Sensors

Observations



The PROV Ontology (PROV-O)



Building topology

Sensors

Observations



Building Topology Ontology (BOT)



Semantic Sensor Network Ontology (SSN)

Select level

Niveau 04

Color by

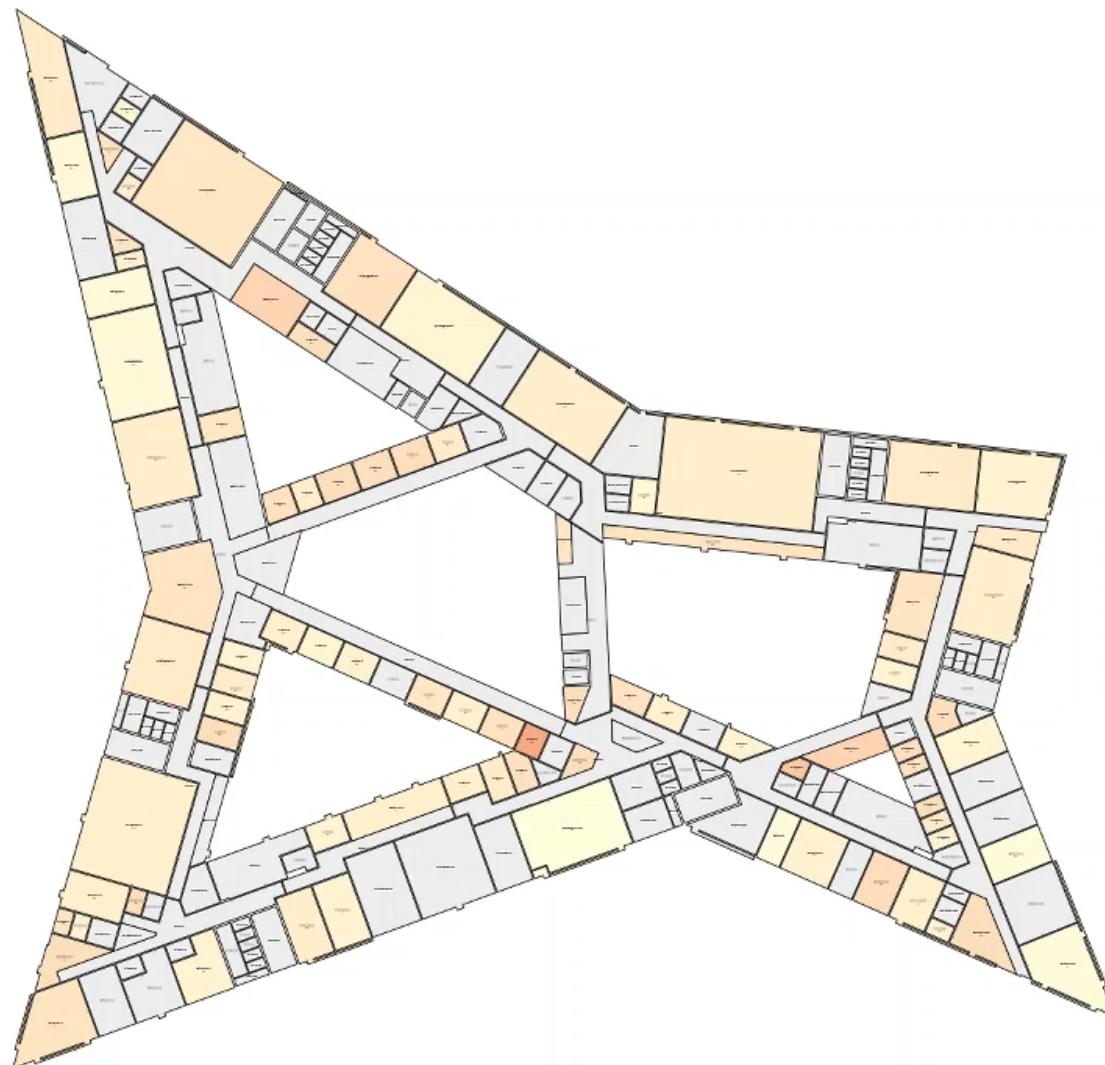
Max temperature

2D

3D



Show info



Press and hold "Alt" to pan

What could the system architecture look like?



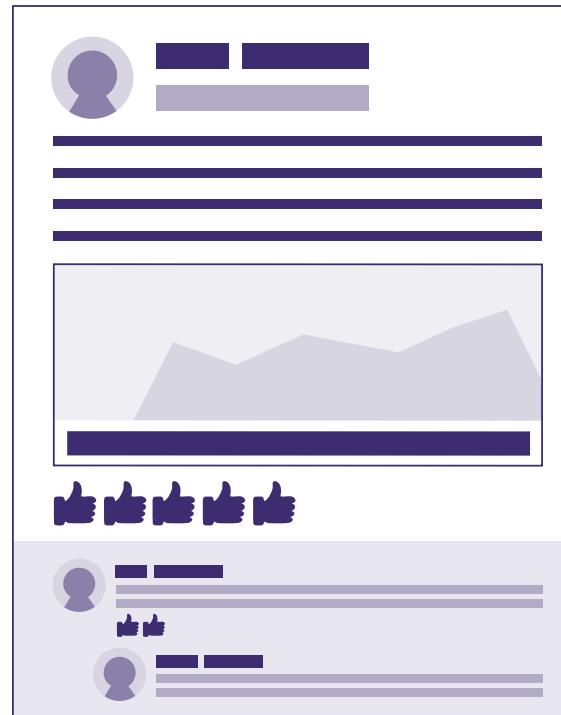
Author's name and latest profile picture
stored in author's personal data pod

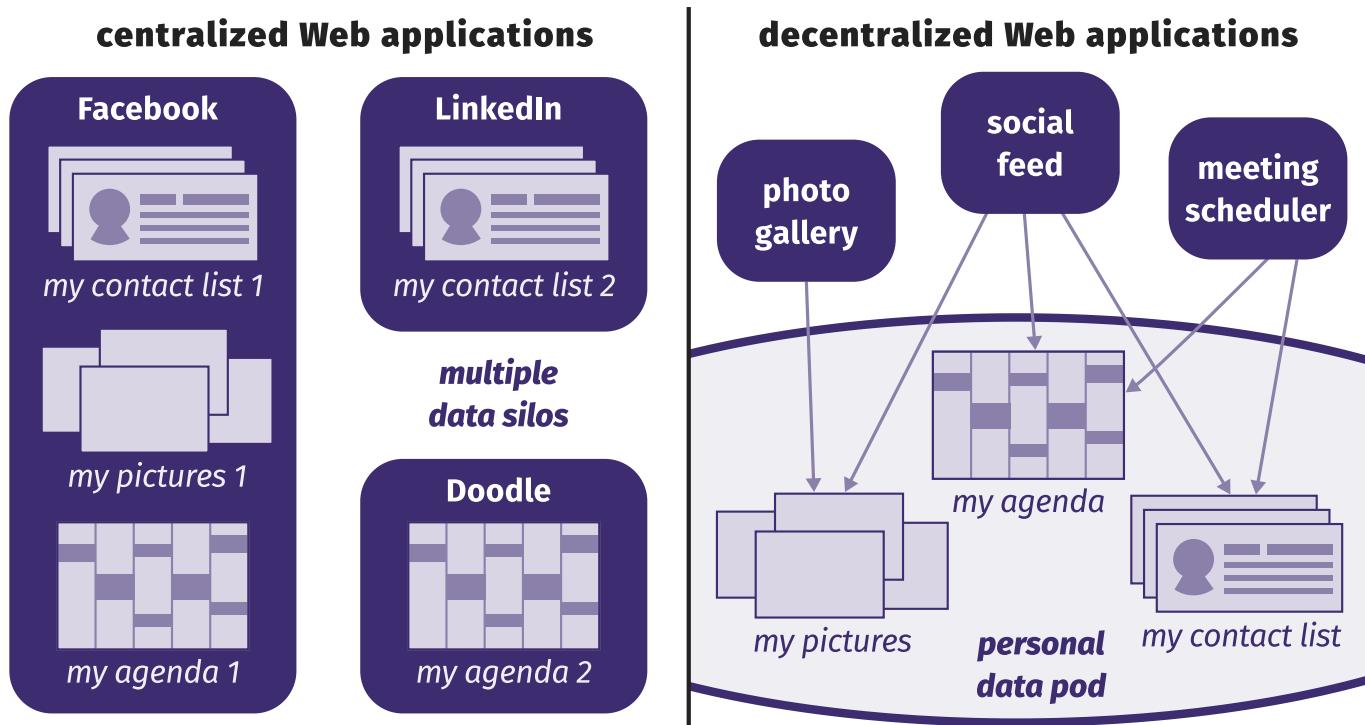
Work-related opinion about an article
stored in data pod of author's company

Discussed article title and photo
stored in news website's data pod

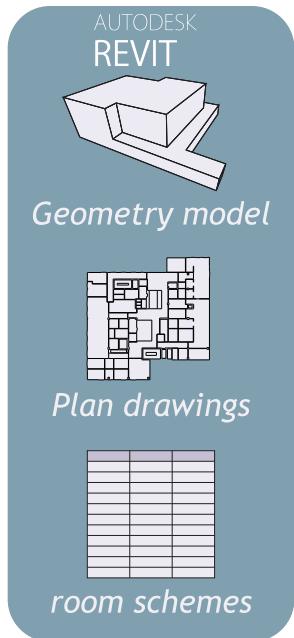
Likes on this post
each one in different individuals' data pods

Comments on this post
each one in different individuals' data pods

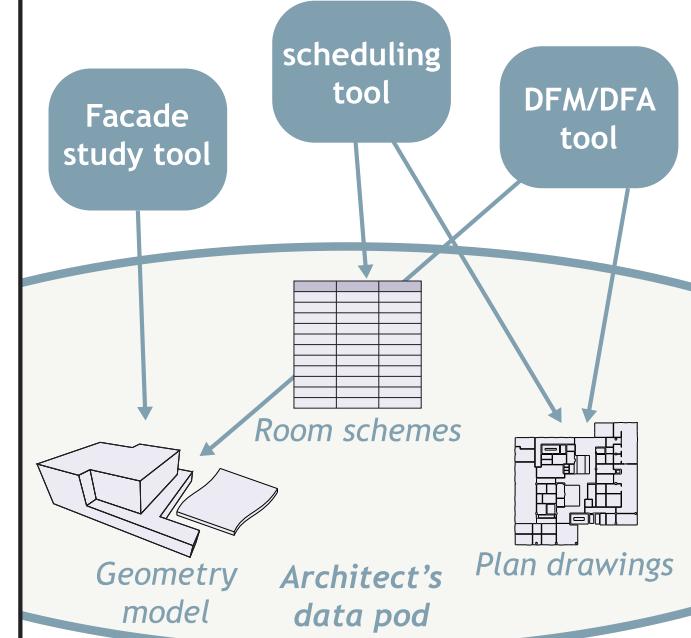


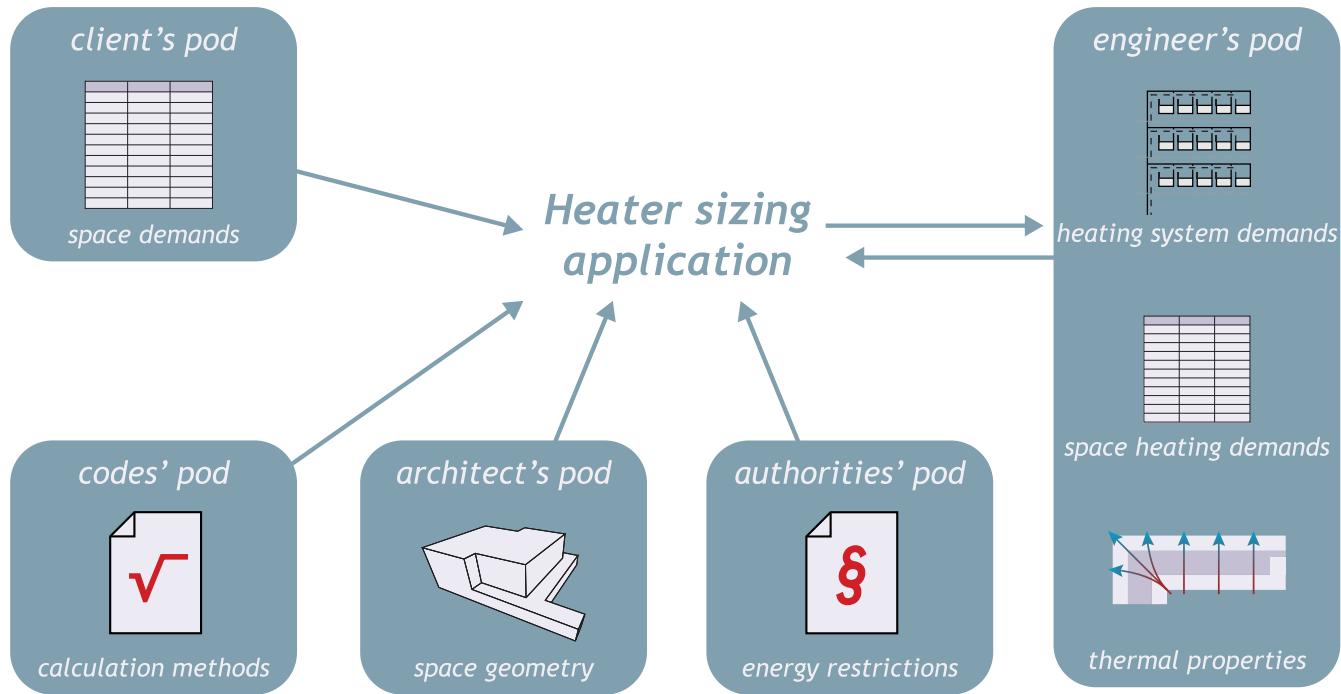


centralized ~~Web~~ applications



decentralized Web applications





Small, task-specific applications rather than large monolithic systems

Who should define the terminology?

DS Dansk standard

DS/EN 15251

1. udgave

2007-06-22

Input-parametre til indeklimaet ved design og bestemmelse af bygningers energimæssige ydeevne vedrørende indendørs luftkvalitet, termisk miljø, belysning og akustik

Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

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DANSK STANDARD
Dansk Standard

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Tel +45 39 98 61 01
Fax +45 39 98 61 02
e-mail: standard@ds.dk
www.ds.dk

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EN 15193 Energy performance of buildings — Energy requirements for lighting

EN 15241 Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings

EN 15242 Ventilation for buildings — Calculation methods for the determination of air flow rates in buildings including infiltration

prEN 15255 Thermal performance of buildings — Sensible room cooling load calculation — General criteria and validation procedures

prEN 15265 Thermal performance of buildings — Calculation of energy needs for space heating and cooling using dynamic methods — General criteria and validation procedures

EN ISO 7726 Ergonomics of the thermal environment — Instruments for measuring physical quantities (ISO 7726:1998)

EN ISO 7730 Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria (ISO 7730:2005)

EN ISO 8996 Ergonomics of the thermal environment — Determination of metabolic rate (ISO 8996:2004)

EN ISO 9920 Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble (ISO 9920:1995)

EN ISO 13731 2001 Ergonomics of the thermal environment — Vocabulary and symbols (ISO 13731:2001)

EN ISO 13790 Thermal performance of buildings — Calculation of energy use for space heating (ISO 13790:2004)

ISO/TS 14415 Ergonomics of the thermal environment — Application of International Standards to people with special requirements

CIE 69 Methods of characterizing illumination meters and luminance meters; performance, characteristics and specifications

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN IEC 62080, EN ISO 13731:2001, EN 12664-1:2002 and the following apply.

3.1 adaptation physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment in order to avoid discomfort

NOTE In naturally ventilated buildings these are often in response to changes in indoor environment induced by outside weather conditions.

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EN 15251:2007 (E)

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NOTE In naturally ventilated buildings these are often in response to changes in indoor environment induced by outside weather conditions.

3.2 active cooling
see mechanical cooling

3.3 buildings, very low-polluting
buildings where an extraordinary effort has been done to select low-emitting materials and activities with emission of pollutants are prohibited and no previous emitting sources (like tobacco smoke) was present

NOTE Criteria are listed in Annex G.

3.4 buildings, low-polluting
buildings where an effort has been done to select low-emitting materials and activities with emission of pollutants are limited or prohibited

NOTE Criteria are listed in Annex G.

3.5 buildings, not low-polluting
old or new buildings where no effort has been done to select low-emitting materials and activities with emission of pollutants not prohibited

NOTE Previous emissions (like tobacco smoke) may have taken place.

3.6 buildings without mechanical cooling
buildings that do not have any mechanical cooling and rely on other techniques to reduce high indoor temperature during the warm season like moderately-sized windows, adequate sun shielding, use of building mass, natural ventilation, night time ventilation etc. for preventing overheating

3.7 cooling season
part of the year during which (at least parts of the day and part of the building, usually summer) cooling appliances are needed to keep the indoor temperatures at specified levels

NOTE The length of the cooling season differs substantially from country to country and from region to region.

3.8 daylight factor (D)
ratio of the illuminance at a point on a given indoor plane due to the light received directly or indirectly from the sky or assumed or known illuminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of the sky. The contribution of direct sunlight to both illuminances is excluded

[EN 12665:2002]

NOTE usually expressed as a percentage

3.9 demand controlled ventilation
ventilation system where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation

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 Dansk standard DS DS/EN 15251 1. udgave 2007-06-22	EN 15193 <i>Energy performance of buildings — Energy requirements for lighting</i> EN 15241 <i>Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings</i> EN 15251 <i>Ventilation for buildings — Calculation methods for energy losses due to ventilation and infiltration in commercial buildings</i>	EN 15251:2007 (E) EN 15251:2007 (E) EN 15251:2007 (E) 3.2 active cooling see mechanical cooling 3.3 buildings, very low-polluting buildings where no emissions of tobacco smoke was to select low-emitting materials and activities from low-emitting sources (like tobacco smoke) was to select low-emitting materials and activities with emission select low-emitting materials and activities with emission
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3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12792:2003, EN ISO 13731:2001, EN 12464-1:2002 and the following apply.

<p>COPYRIGHT Dansk Standard - NOT FOR COMMERCIAL USE ONLY</p> <p>Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics</p> <p>DANSK STANDARD Dansk Standard</p> <p>Købmagergade 6 DK-2920 Charlottenlund Tel: +45 39 96 61 01 Fax: +45 39 96 61 02 email: standard@ds.dk www.ds.dk</p> <p>© Dansk Standard - Effektivt uden tilslutning forbudt</p> <p>User license: ALECTIA A/S</p>	<p>COPYRIGHT Dansk Standard - NOT FOR COMMERCIAL USE ONLY</p> <p>EN ISO 8996 <i>Ergonomics of the thermal environment — Determination of metabolic rate (ISO 8996:2004)</i></p> <p>EN ISO 9920 <i>Ergonomics of the thermal environment — Estimation of the thermal insulation and evaporative resistance of a clothing ensemble (ISO 9920:1995)</i></p> <p>EN ISO 13731 2001 <i>Ergonomics of the thermal environment — Vocabulary and symbols (ISO 13731:2001)</i></p> <p>EN ISO 13790 <i>Thermal performance of buildings — Calculation of energy use for space heating (ISO 13790:2004)</i></p> <p>ISO/TS 14415 <i>Ergonomics of the thermal environment — Application of International Standards to people with special requirements</i></p> <p>CIE 69 <i>Methods of characterizing illumination meters and luminance meters; performance, characteristics and specifications</i></p> <p>3 Terms and definitions</p> <p>For the purposes of this document, the terms and definitions given in EN 12792:2003, EN ISO 13731:2001, EN 12464-1:2002 and the following apply:</p> <p>3.1 adaptation physiological, psychological or behavioural adjustment of building occupants to the interior thermal environment in order to avoid discomfort</p> <p>NOTE In naturally ventilated buildings these are often in response to changes in indoor environment induced by outside weather conditions.</p> <p>User license: ALECTIA A/S</p>	<p>COPYRIGHT Dansk Standard - NOT FOR COMMERCIAL USE ONLY</p> <p>NOTE Previous emissions (like tobacco smoke) may have taken place.</p> <p>3.6 buildings without mechanical cooling Buildings that do not have any mechanical cooling and rely on other techniques to reduce high indoor temperature during the warm season like moderately-sized windows, adequate sun shielding, use of building mass, natural ventilation, night time ventilation etc. for preventing overheating</p> <p>3.7 cooling season part of the year during which (at least parts of the day and part of the building, usually summer) cooling appliances are needed to keep the indoor temperatures at specified levels</p> <p>NOTE The length of the cooling season differs substantially from country to country and from region to region.</p> <p>3.8 daylight factor (D) ratio of the illuminance at a point on a given indoor plane due to the light received directly or indirectly from the sky of assumed or known illuminance distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of the sky. The contribution of direct sunlight to both illuminances is excluded</p> <p>[EN 12665:2002]</p> <p>NOTE usually expressed as a percentage</p> <p>3.9 demand controlled ventilation ventilation system where the ventilation rate is controlled by air quality, moisture, occupancy or some other indicator for the need of ventilation</p> <p>User license: ALECTIA A/S</p>
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Dansk standard

DS/EN 15251

1. udgave
2007-06-22

Input-parametre til indeklimaet ved design og bestemmelse af bygningers energimæssige ydeevne vedrørende indendørs luftkvalitet, termisk miljø, belysning og akustik

Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics

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DS/EN 15251:2007 (E)

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EN ISO 13790 Thermal performance of buildings — Calculation of energy use for space heating (ISO 13790:2004)

ISO/TS 14416 Methods of characterizing illuminance meters and luminance meters, performance, characteristics and specifications

ISO 15999 1 Terms and definitions

EN 15251:2007 (E)

3.2 active cooling
see mechanical cooling

3.3 buildings, very low-polluting
buildings where an extraordinary effort has been done to select low-emitting materials and activities with emission of pollutants are prohibited and no previous emitting sources (like tobacco smoke) was present

NOTE Criteria are listed in Annex G.

3.4 buildings, low-polluting
buildings where an effort has been done to select low-emitting materials and activities with emission of pollutants are limited or prohibited

NOTE Criteria are listed in Annex G.

3.5 buildings, not low-polluting
old or new buildings where no effort has been done to select low-emitting materials and activities with emission of pollutants not prohibited

NOTE Previous emissions (like tobacco smoke) may have taken place.

3.6 buildings without mechanical cooling
buildings that do not have any mechanical cooling and rely on other techniques to reduce high indoor temperature during the warm season like moderately-sized windows, adequate sun shading, use of building mass, natural ventilation, night time ventilation etc. for preventing overheating

3.7 cooling season
part of the year during which (at least parts of the day and part of the week, usually summer) cooling appliances are needed to keep the indoor temperatures at specified levels

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3.8 daylight factor (D)
ratio of the illuminance at a point on a given indoor plane due to the direct and/or indirect light received directly or indirectly from the sky of assumed or known illumination distribution, to the illuminance on a horizontal plane due to an unobstructed hemisphere of this sky. The contribution of direct sunlight to both illuminances

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NOTE Criteria are listed in Annex G.

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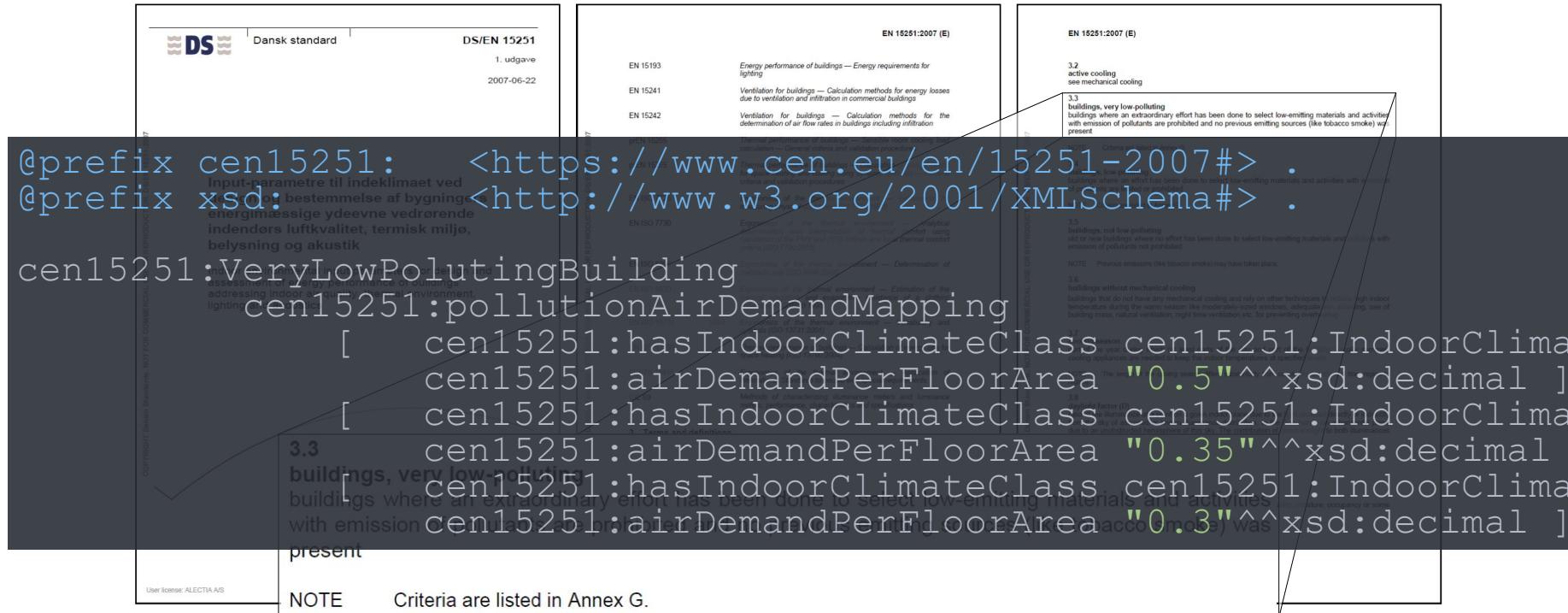
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  rdfs:label "Buildings, very low-polluting"@en , "Bygninger, meget lavt-forurenende"@da ;
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  rdfs:subClassOf cen15251:BuildingPollutionCategory .

  
```

3.3 buildings, very low-polluting
 buildings where an extraordinary effort was made to select low-emitting materials and activities, where no pollutants are prohibited and no previous emitting sources (like tobacco smoke) was present.

NOTE: Criteria are listed in Annex G



The logo consists of the word "NIRAS" in a bold, red, sans-serif font. The letter "I" has a small, curved red stroke extending upwards and to the right.

NIRAS approach

- Use what is already out there
- Extend with Niras-specific terminology when needed
- Encourage standardisation organisations to publish RDF
- Link and align own terminology as standards become available in RDF

Other cool stuff...

There exists a standards rule language called SHACL

With RDFa it can be embedded directly inside HTML-pages

The technologies are widely used in other industries
and are therefore continuously being developed

There are both commercial and open source
triplestores available

Let's dream a bit!

Imagine material properties automatically being inherited simply by describing the material as <<https://materialDB/concrete2300>> instead of just "concrete"

Imagine that the placeholder product used in the design model can be automatically matched against what is available on the market. Like a
Skyscanner for building products

Imagine if building regulations were published as SHACL rules such that
compliance checking could be automated.

Imagine if manufacturers could **publish LCA data** on their products. Innovative production methods yield lower climate impact but designers depend on data from generic databases.

Let's give the manufacturers an extra incentive to make better products!

What if the controls and systems used in indoor climate simulations were transferred to the actual systems?

What if all contexts of a sensor (what room, what system, where in the system) were modeled in the design stages and therefore directly available for the Digital Twin?

Embrace the technology and go innovate the industry!

Tak for opmærksomheden 😊