DARIAH-EU

Archetipo
WORKING GROUP

Semantic web approach for built heritage representation

Stefano Cursi

INTERNATIONAL WORKSHOP
DIGITAL INTEGRATED STRATEGIES TO SAFEGUARD HERITAGE CONSTRUCTION TECHNOLOGIES
September 30 - October 5, 2024 | Poggioreale, Trapani

Data, Information, and Knowledge

Semantic web approach for built heritage representation

Data: Raw facts and figures without context. Examples: numbers, dates.

Information: Processed data that has context, meaning. Example: a date associated with an event.

Knowledge: Information combined with experience and insights, allowing for informed decision-making.

Dealing with a Knowledge dilemma

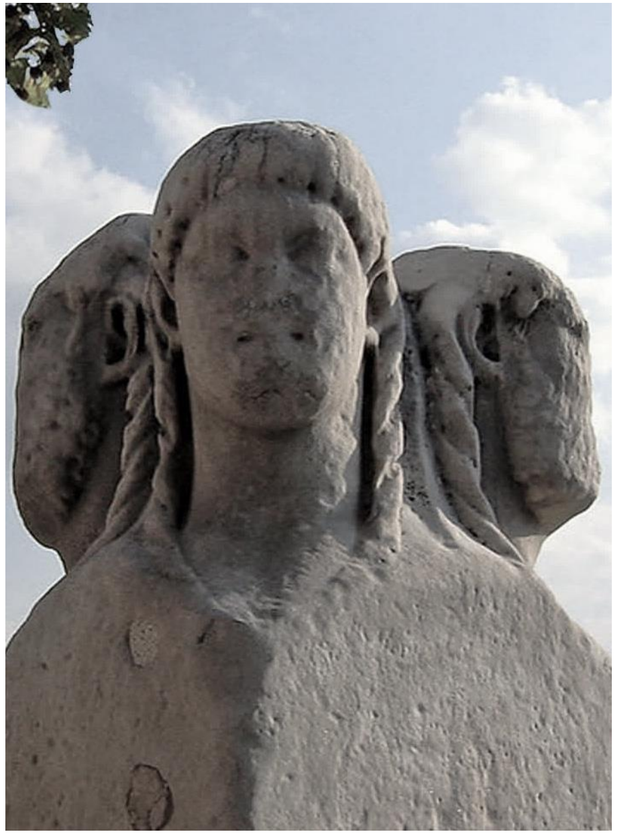
Semantic web approach for built heritage representation

Assertive

La Madonna della Pietà,

Map of Rome carved on the facade of the church of Santa Maria del Giglio, XVII cent.

Pluri-semantic



Giano Quadrifronte

Multi-probabilistic

Pietà Rondanini, Michelangelo

What is Semantic Web?

Semantic web approach for built heritage representation

The **Semantic Web** is an extension of the current web, where data is structured in a way that it can be understood and processed by machines. It uses standards such as RDF and OWL to represent data in a way that both humans and machines can interpret.

What are Ontologies?

Semantic web approach for built heritage representation

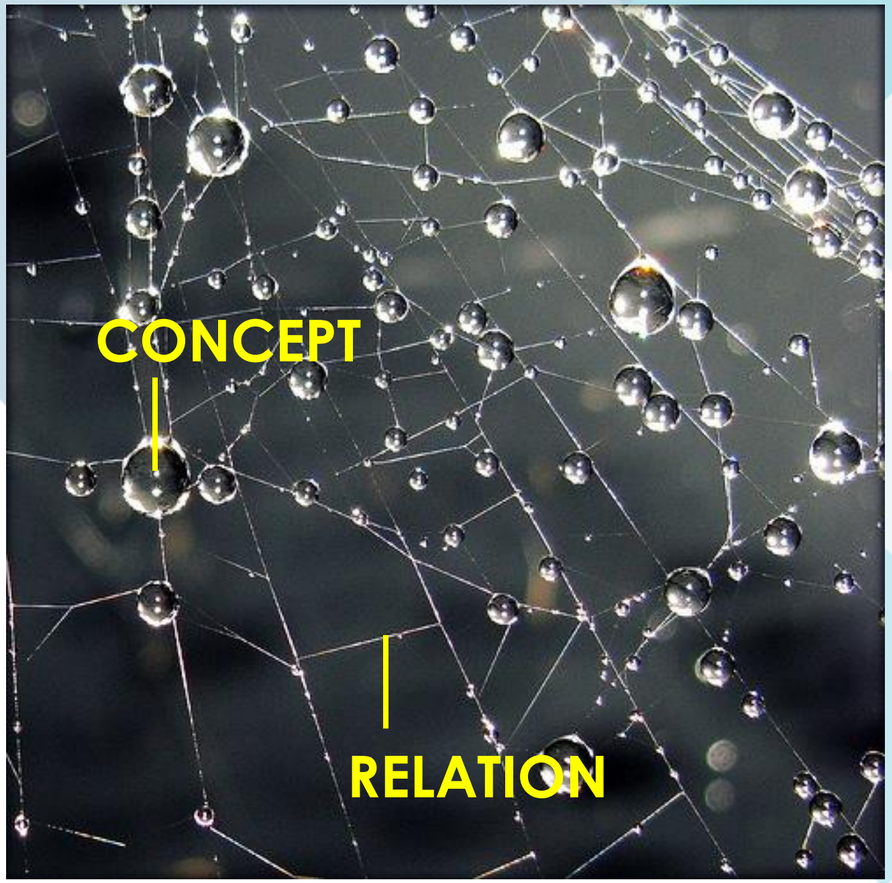
In the ICT context **ontology** is…

a formal representation of concepts and their relationships within a specific domain.

It defines a common vocabulary so that information in a particular domain can be shared.

Enables machines to read and interpret that information facilitating tasks such as data integration, etc..

It provides a common framework that helps sharing and reusing knowledge across different applications and domains.



"An ontology is a formal, explicit specification of a shared conceptualization"

(Gruber, T. 1993)

How Ontologies and Semantic Web Work Together

Semantic web approach for built heritage representation

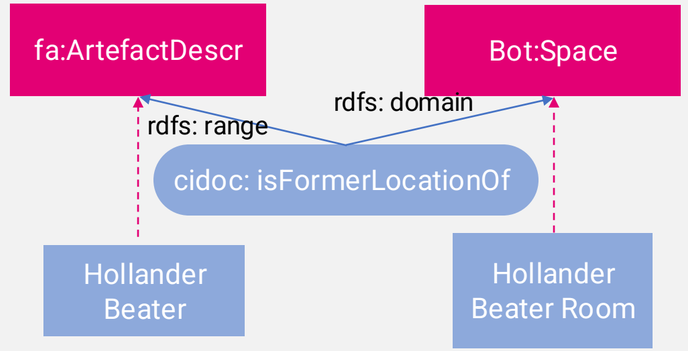
RDF Triple Representation


```
@prefix ex: <http://example.org/> .
@prefix fa: <http://example.org/artefact/> .
@prefix cidoc: <http://www.cidoc-crm.org/cidoc-crm/> .
@prefix bot: <https://w3id.org/bot#> .

ex:HollanderBeater a fa:ArtefactDescr .

ex:HollanderBeaterRoom a bot:Space ;
   cidoc:isFormerLocationOf ex:HollanderBeater .
```

OWL Representation




```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
      xmlns:owl="http://www.w3.org/2002/07/owl#"
      xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
      xmlns:fa="http://example.org/artefact/"
      xmlns:cidoc="http://www.cidoc-crm.org/cidoc-crm/"
      xmlns:bot="https://w3id.org/bot#">

 <owl:Class rdf:about="fa:ArtefactDescr"/>
 <owl:Class rdf:about="bot:Space"/>

 <owl:ObjectProperty rdf:about="cidoc:isFormerLocationOf">
  <rdfs:domain rdf:resource="bot:Space"/>
  <rdfs:range rdf:resource="fa:ArtefactDescr"/>
 </owl:ObjectProperty>
</rdf:RDF>
```

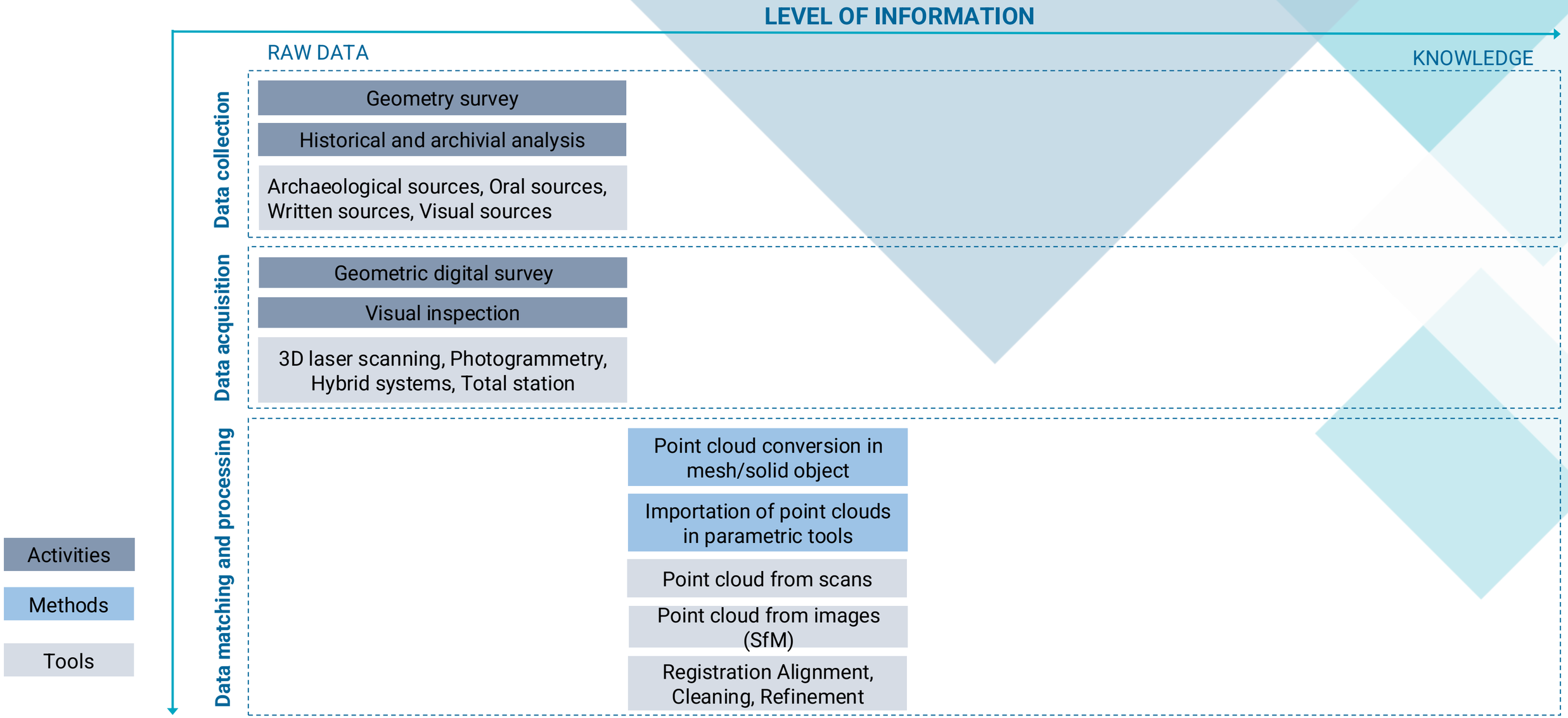
Query SPARQL Protocol

```
PREFIX ex: <http://example.org/>
PREFIX fa: <http://example.org/artefact/>
PREFIX cidoc: <http://www.cidoc-crm.org/cidoc-crm/>
PREFIX bot: <https://w3id.org/bot#>

SELECT ?artifact
WHERE {
  ex:HollanderBeaterRoom cidoc:isFormerLocationOf
?artifact .
}
```

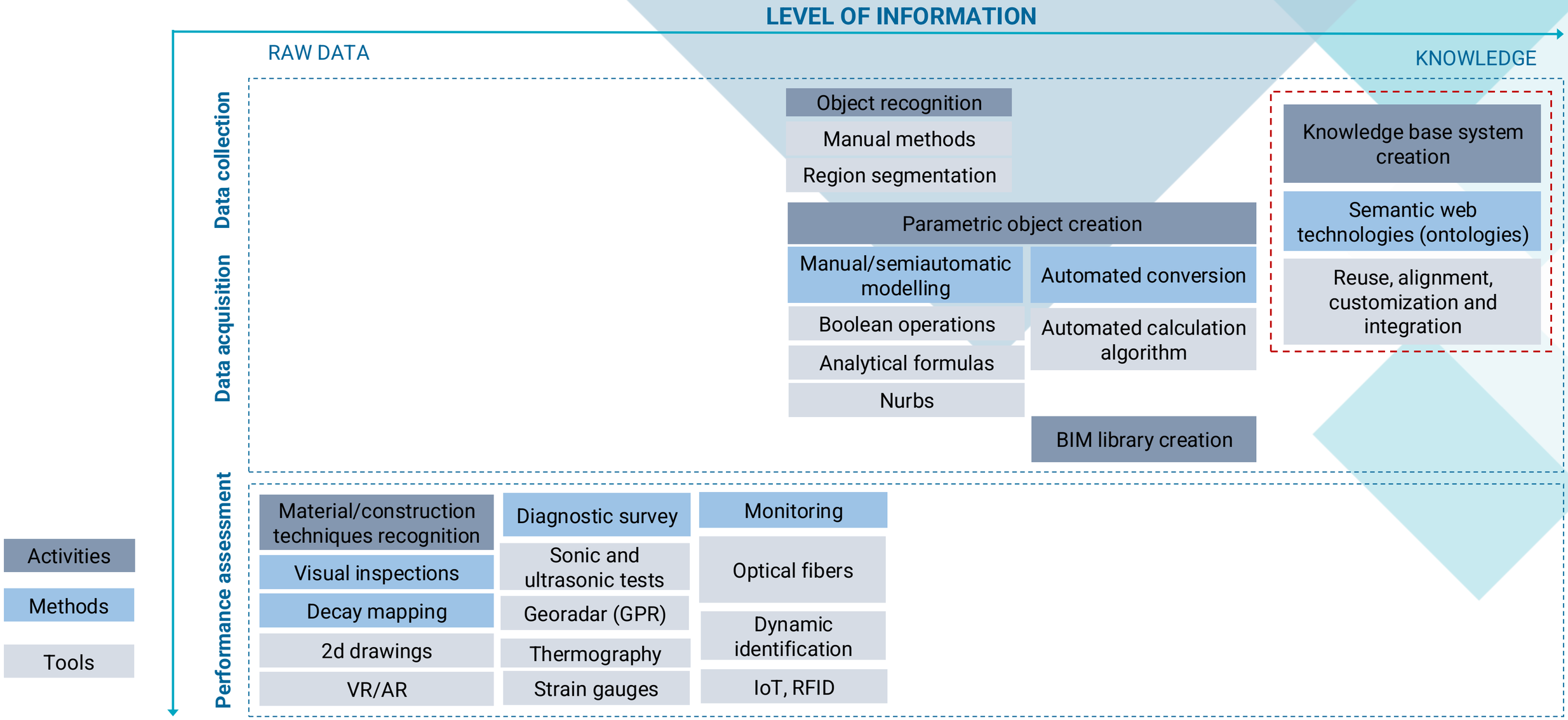
Built heritage representation process

Semantic web approach for built heritage representation



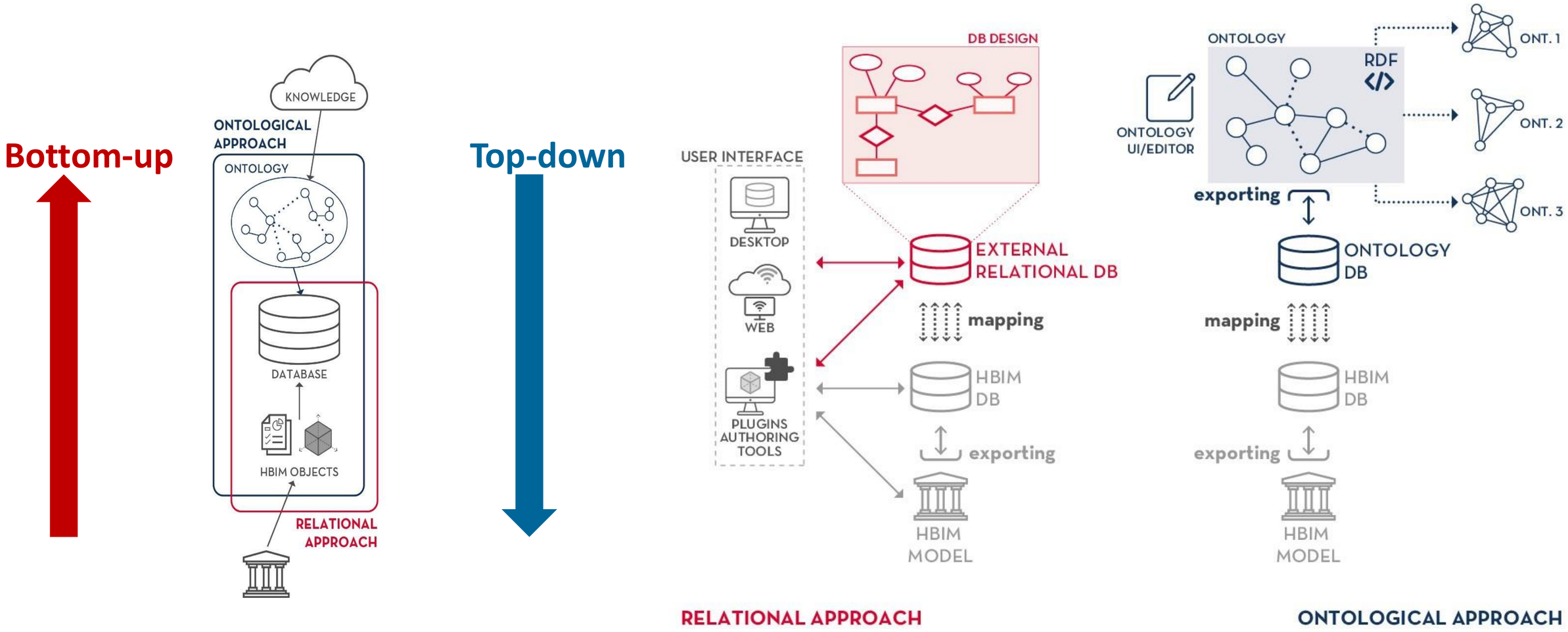
Built heritage representation process

Semantic web approach for built heritage representation



Approaches for HBIM Semantic Enrichment

Semantic web approach for built heritage representation

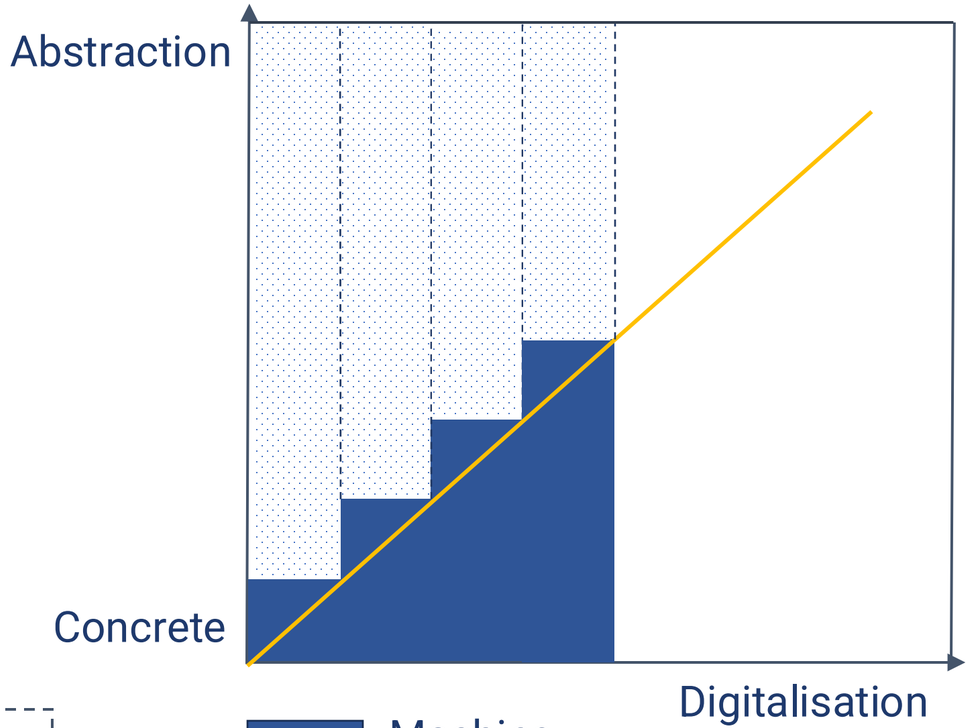


* Cursi S, Martinelli L, Paraciani N, Calcerano F, Gigliarelli E (2022). Linking external knowledge to heritage BIM. AUTOMATION IN CONSTRUCTION, vol. 141, ISSN: 0926-5805, doi: 10.1016/j.autcon.2022.104444

Challanges in current applications

Semantic web approach for built heritage representation

- **Interoperability**, **alignment** of cataloging systems
- Lack of representation of some domains and limited **semantic description**
- **Rigidity** of representation structure Family, type, instance
- Each type of interpretive process has its own different representation. These are processes that are not represented at the level of **logical connections**
- Processes in which there is a lack of unambiguous information definition. Approaches that have difficulty in supporting **management** and **collaboration** processes in decision-making stages



DATA ACQUISITION AND MATCHING

FARO SCENE

Agisoft Metashape

AUTODESK RECAP PRO

3D MODEL CREATION

Rhinoceros

AUTODESK REVIT

SketchUp

GRAPHISOFT Archicad

SEMANTIC ENRICHMENTC

aïoli

Opentheso

VR SHARING & MONITORING

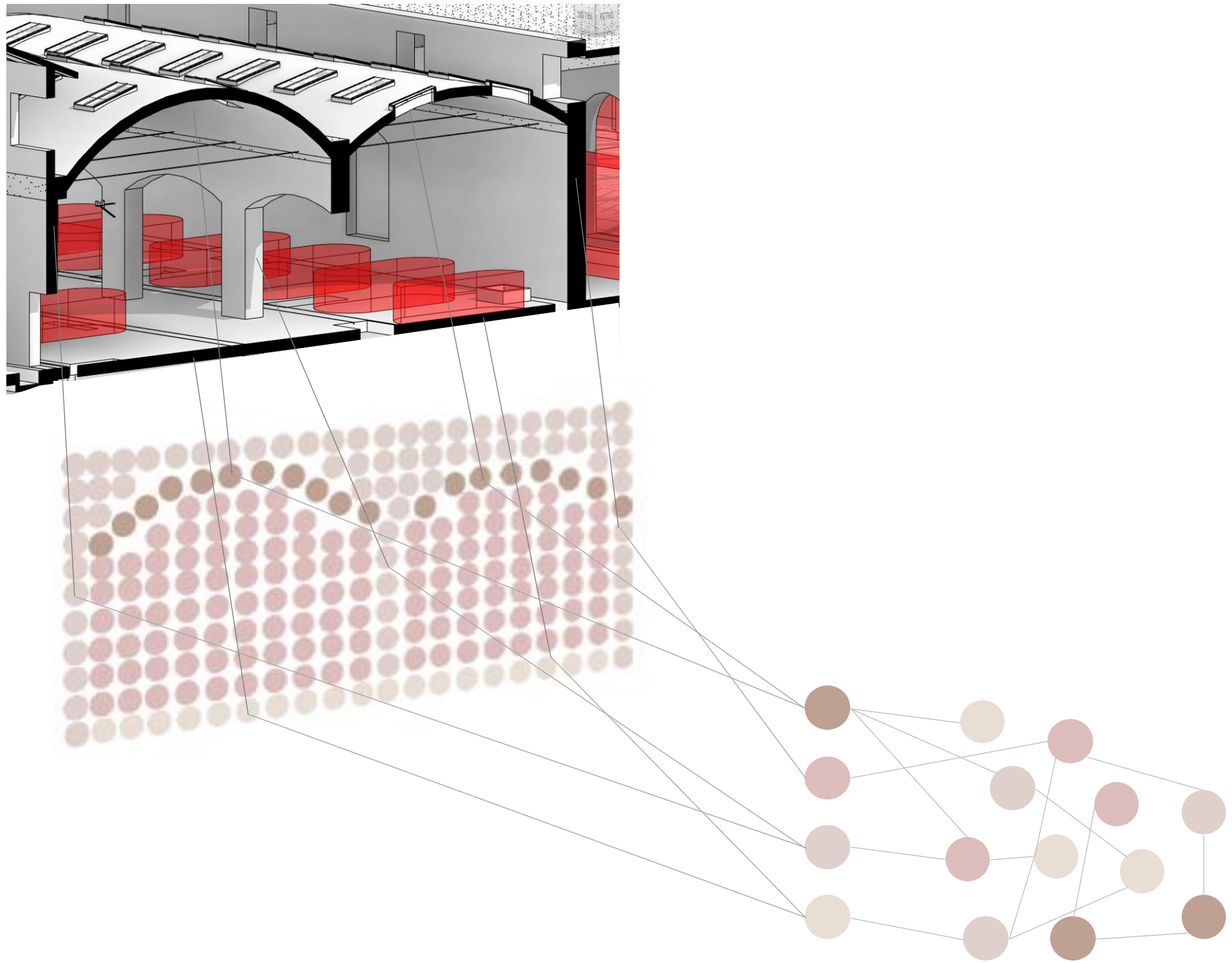
UNREAL ENGINE

EPIC GAMES

Ontologies for HBIM Semantic Enrichment

Semantic web approach for built heritage representation

From web of Documents to Web of data

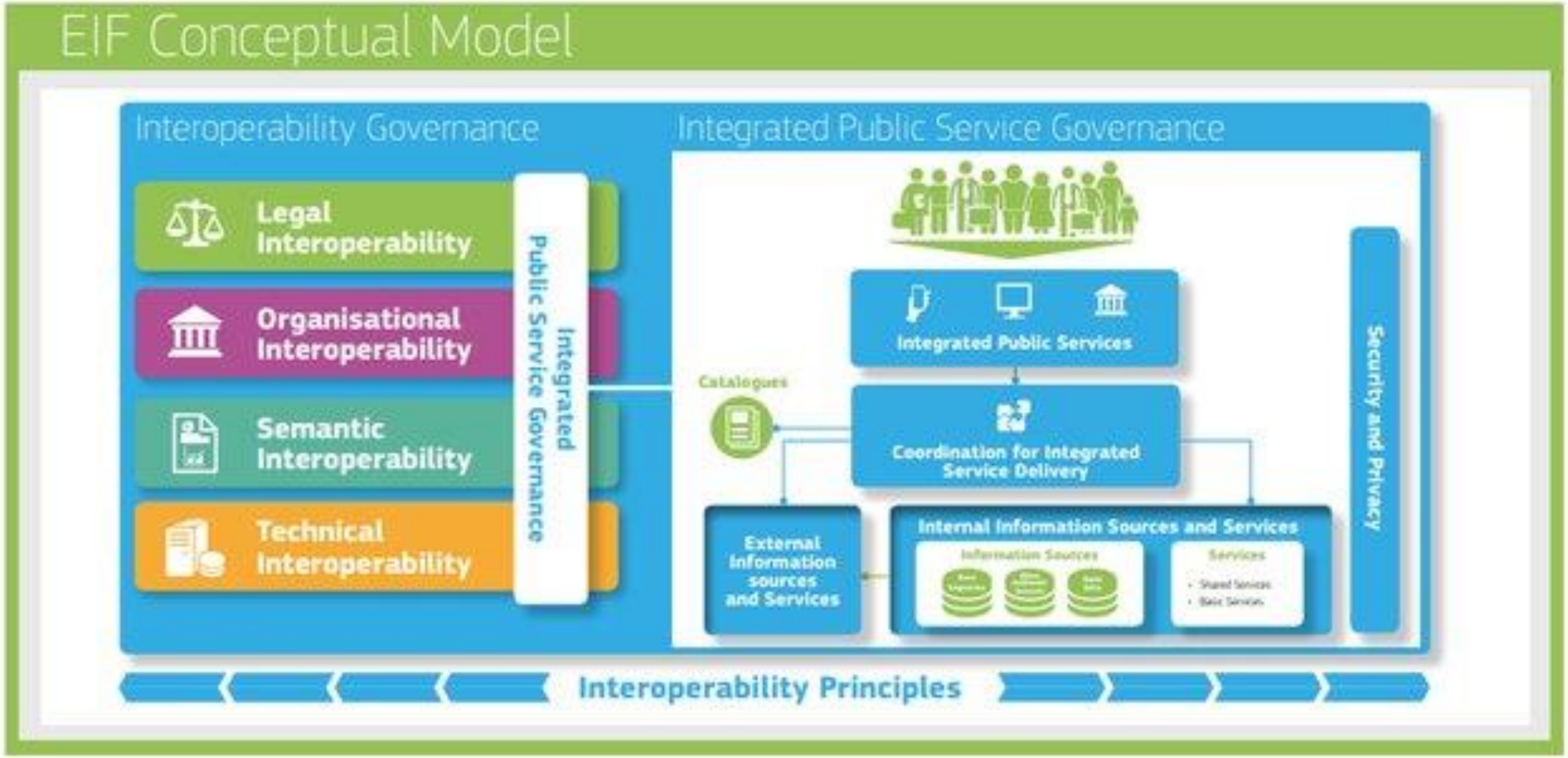


Benefits of Semantic Enrichment in HBIM

- Enhanced **Data Understanding**: Information about historical buildings is better connected.
- Improved **Decision-Making:** Allows experts to access more relevant and context-aware data.
- **Interoperability**: Facilitates better communication between systems using a shared structure.

Ontologies for HBIM Semantic Enrichment

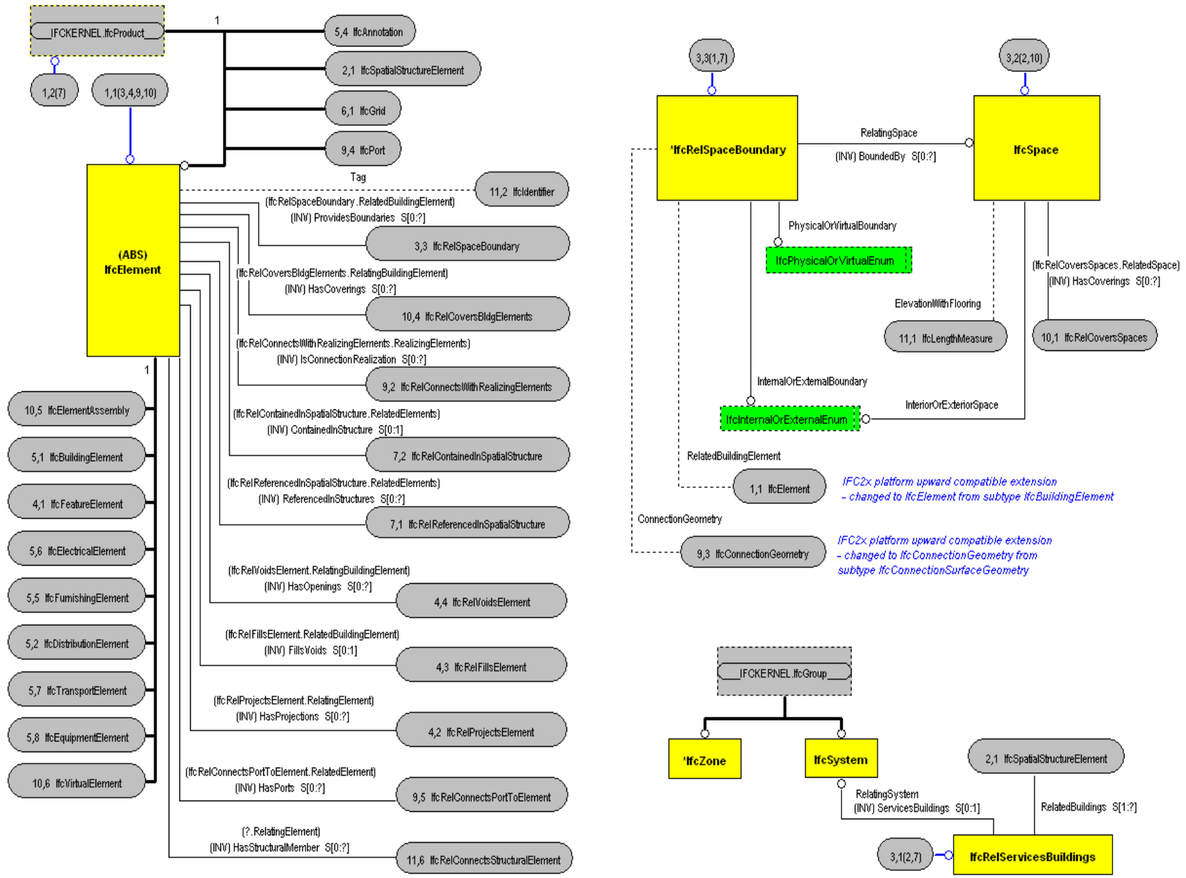
Semantic web approach for built heritage representation



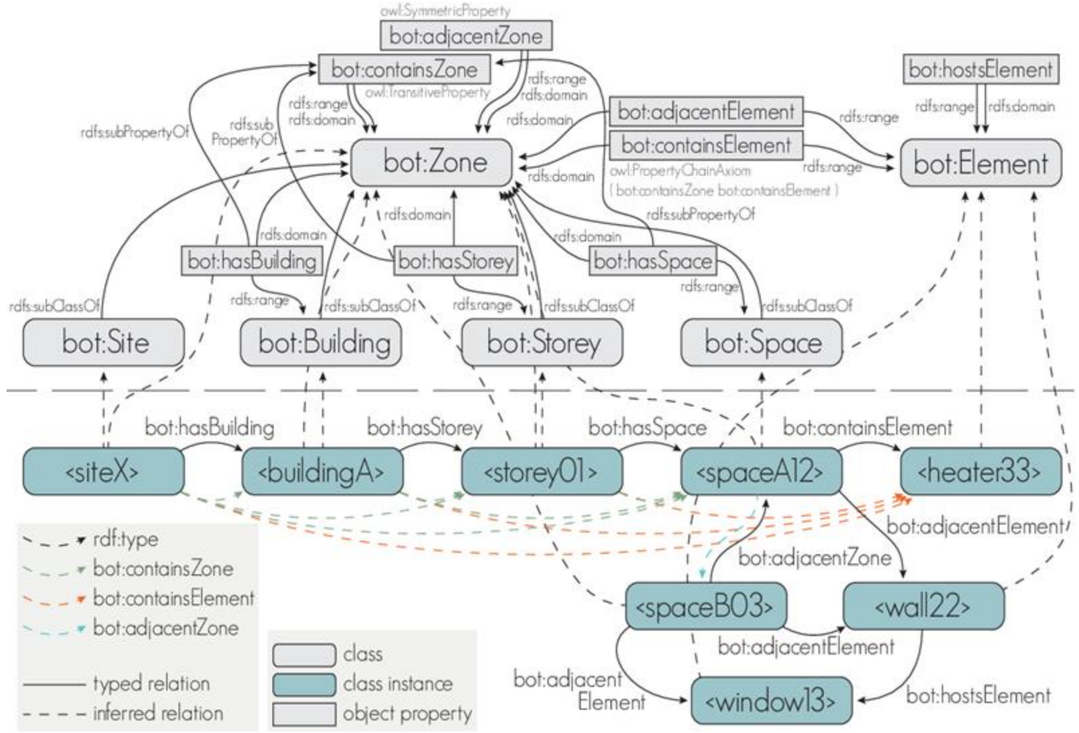
Ontologies in different Domains

Semantic web approach for built heritage representation

AEC INDUSTRY



IFCowl ontology- © BUILDING SMART INTERNATIONAL



BOT ontology- © 2017, Mads Holten Rasmussen et al.

Ontologies in different Domains

Semantic web approach for built heritage representation

CULTURAL HERITAGE

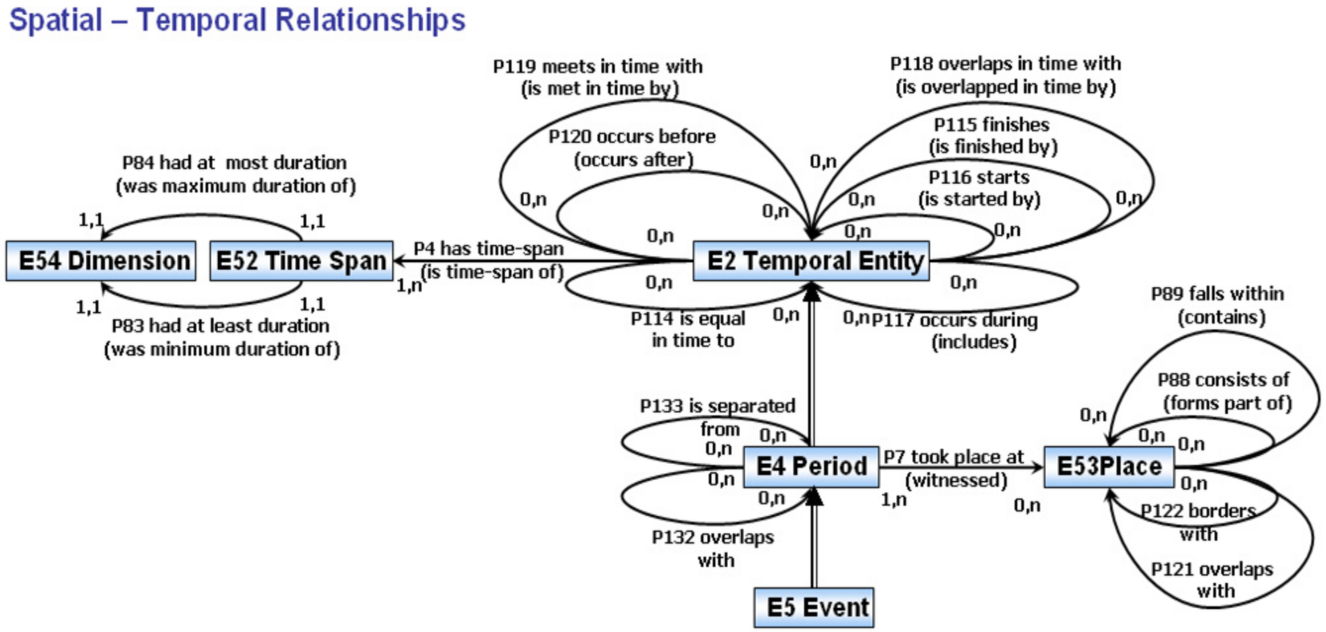


Fig. 4 – CIDOC-CRM for Spatial and Temporal Relations- © 2009, Martin Doerr et al.

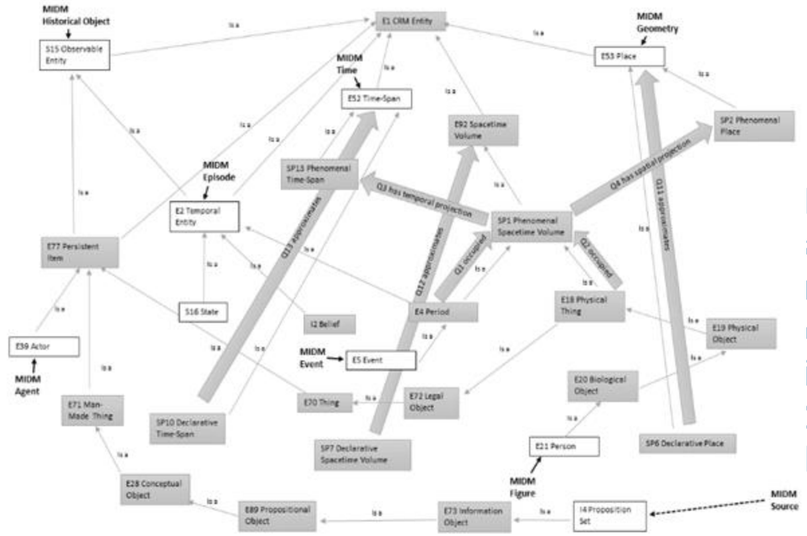


Fig. 5 - CIDOC-CRM and compatible models with the concept of multiple interpretation - © 2017, Muriel Van Ruymbeke et al.

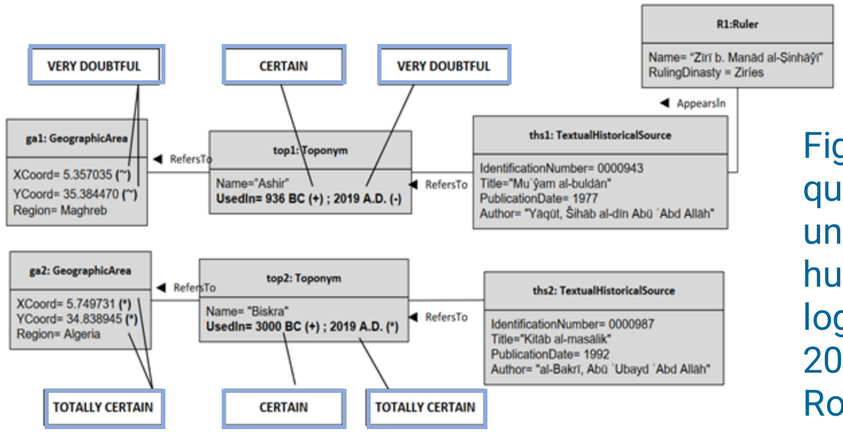
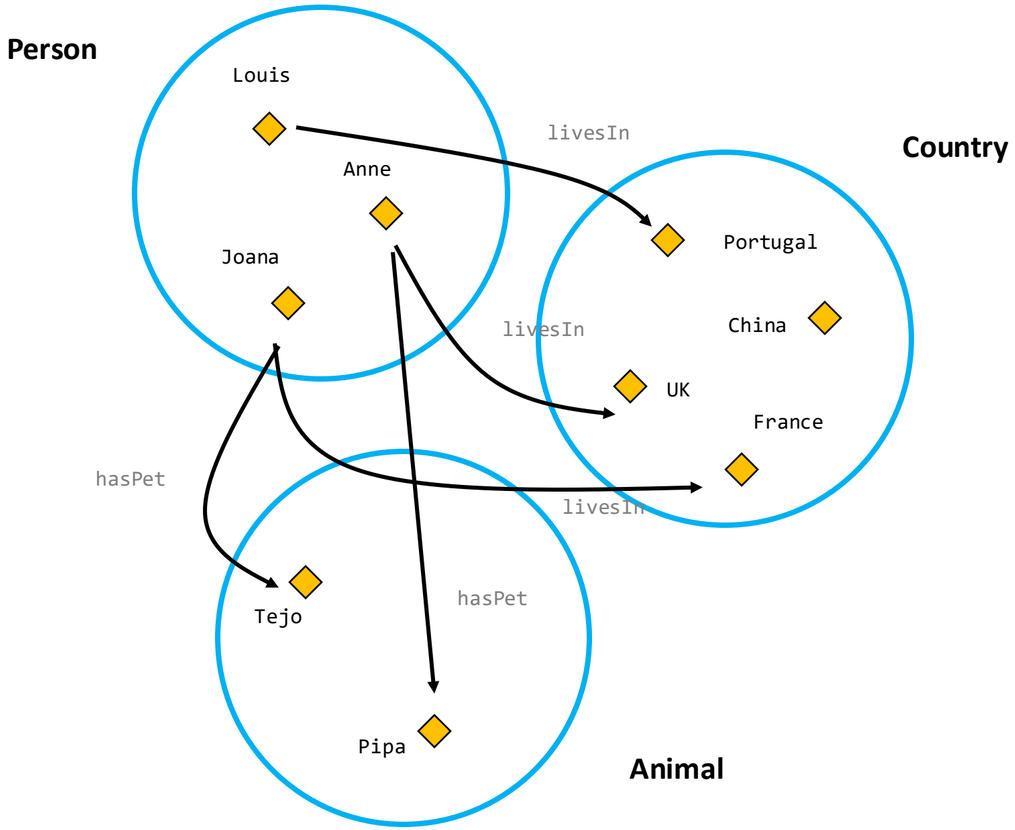


Fig. 6 - Qualifying and quantifying uncertainty in digital humanities: A fuzzy-logic approach. - © 2019, Patricia Martin-Rodilla et al.

What is the structure of an OWL ontology?

Semantic web approach for built heritage representation



Ontologies have the following components:

CLASS It contains individuals and defines the requisites for them to belong to a certain class.

INDIVIDUAL or **INSTANCE** Represents objects in the domain of interest

PROPERTY

Object property or Relationship relates individuals to each other

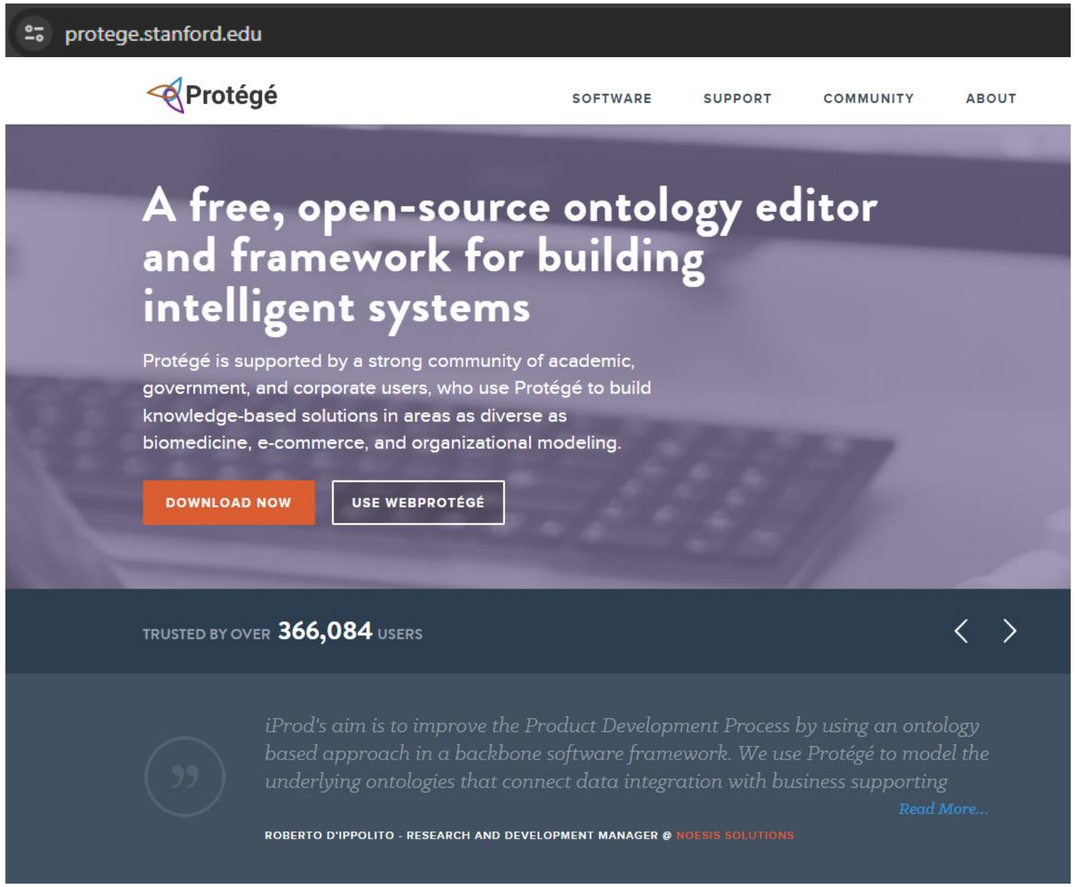
Datatype property link individuals to data values

any of its components is called an **Entity**.

The fundamental construct is a triple Similar to a phrase construction (subject + predicate + object)

How to create an OWL ontology?

Semantic web approach for built heritage representation



Protégé is one of the most common software applications for creating ontologies.

It is OWL-based.

https://protege.stanford.edu/

How to create an OWL ontology?

Semantic web approach for built heritage representation

Some fundamental ruled in Knowledge-Engineering design:

a. There is no one correct way to model a domain.

b. Ontology development is necessarily an iterative process.

c. Concepts in the ontology should be close to objects (physical or logical) and relationships in your domain of interest.

How to create an OWL ontology?

Semantic web approach for built heritage representation

The main steps for creating an ontology are:

1. Determine the domain and scope
2. Reusing existing ontologies
3. Enumerate important terms in the ontology
4. Define classes and their hierarchy
5. Define properties and characteristics
6. Define property restrictions

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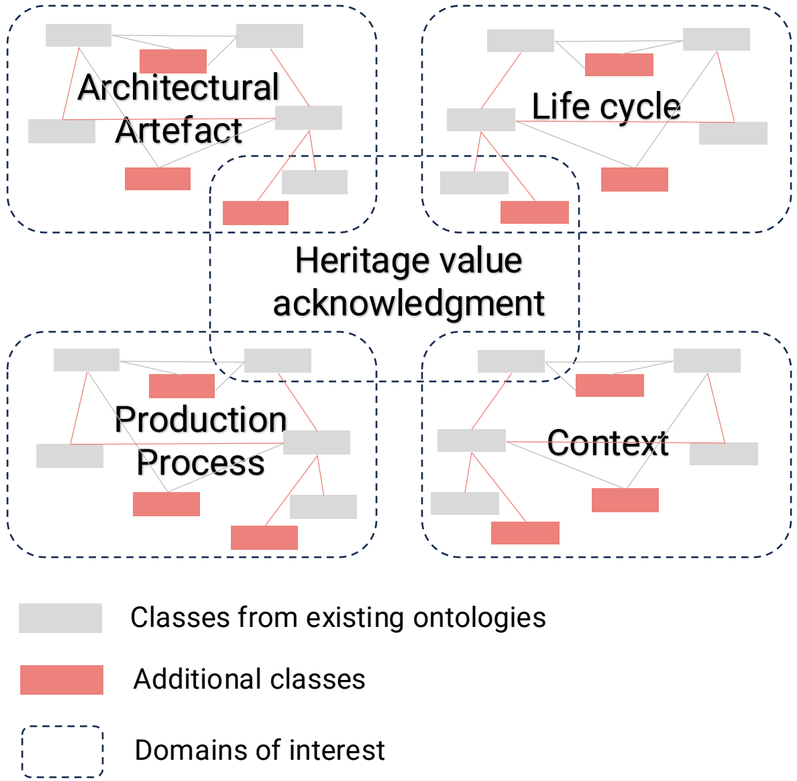

lfc:https://standards.buildingsmart.org/IFC/DEV/IFC2x3/FINAL/OWL
ifcext: http://www.ontoeng.com/IFC4_ADD1_extension#
bot: https://w3c-lbd-cg.github.io/lbd/bot/
fa: http://www.ontoeng.com/factory#
cidoc-crm: http://www.cidoc-crm.org/cidoc-crm
CRMgeo: https://www.cidoc-crm.org/crmgeo/
CRMba: https://cidoc-crm.org/crmba/

How to create an OWL ontology?

Semantic web approach for built heritage representation

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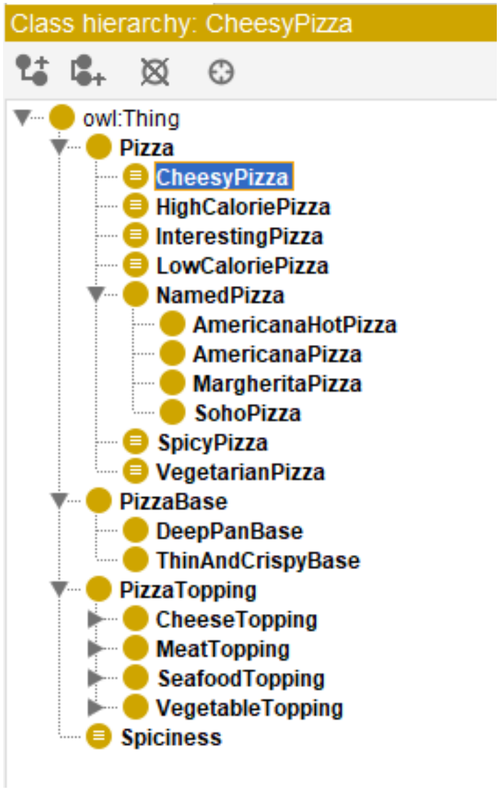
6. Define property restrictions

It is organised according to a hierarchical system:



OWL Class Hierarchy is a tree structure with additional properties and more complex relationships, mainly used for ontologies.

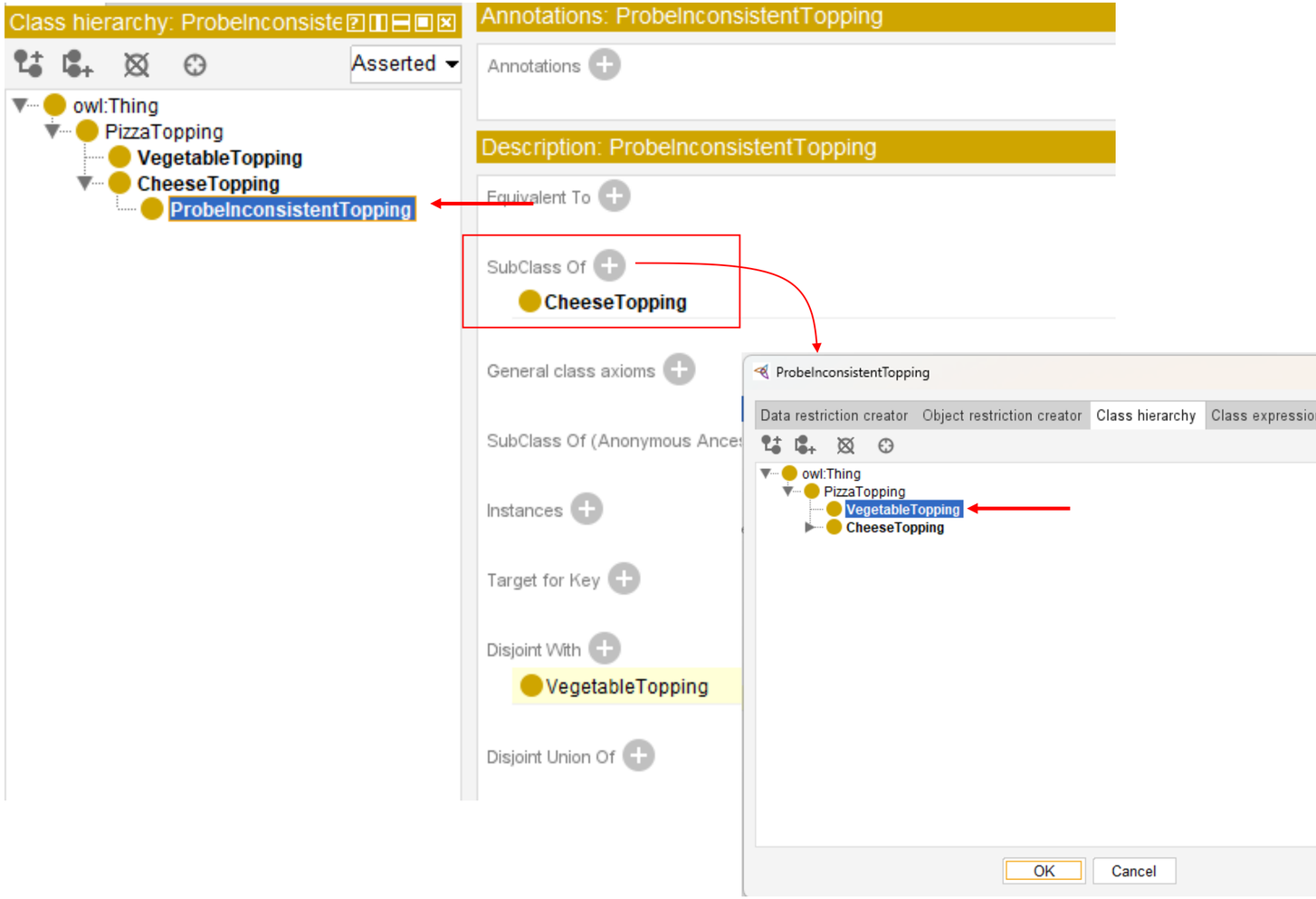
How to create an OWL ontology?

Semantic web approach for built heritage representation

CLASSES

They can be categorised based on their characteristics and how they are defined.

- Primitive classes – Defined with necessary but not sufficient conditions.
- Defined classes – Defined with necessary and sufficient conditions.
- Anonymous classes – Defined by their characteristics without a specific name.
- Disjoint classes – No shared instances.
- Enumerated classes – Instances are explicitly listed.
- Probe classes – Temporary classes for exploration and testing.



How to create an OWL ontology?

Semantic web approach for built heritage representation

The main steps for creating an ontology are:

1. Determine the domain and scope
2. Reusing existing ontologies
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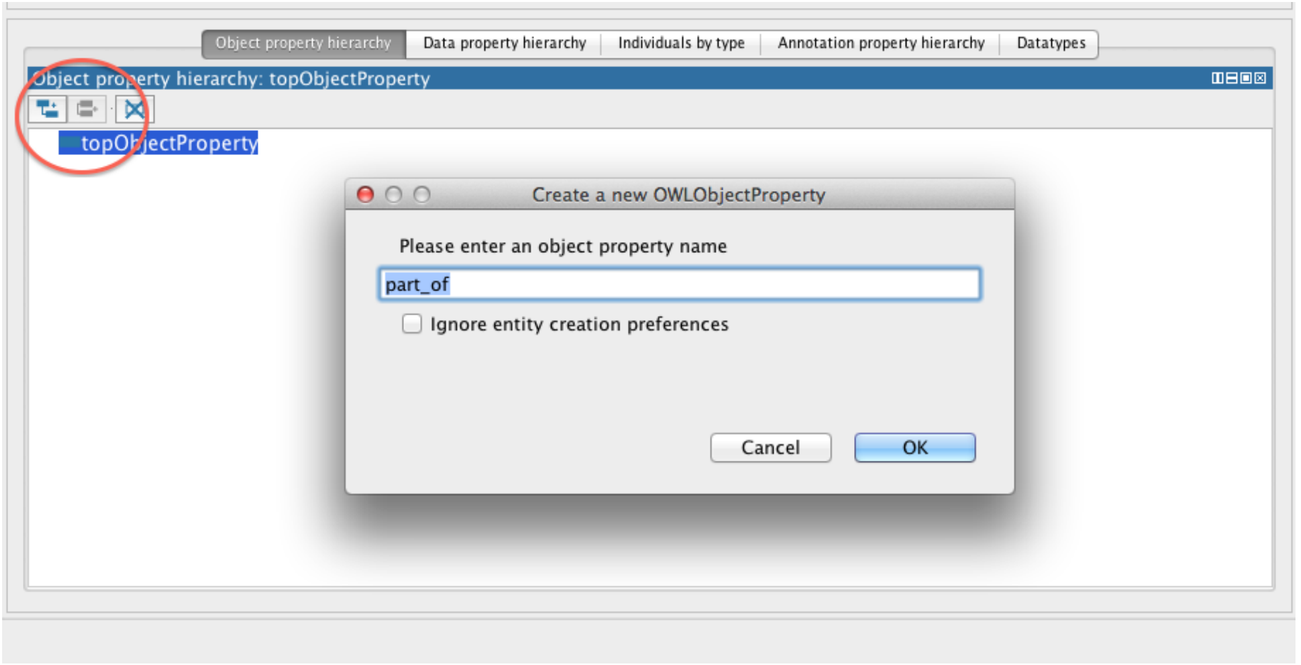
4. Define classes and their hierarchy
5. **Define properties and characteristics**
6. **Define property restrictions**



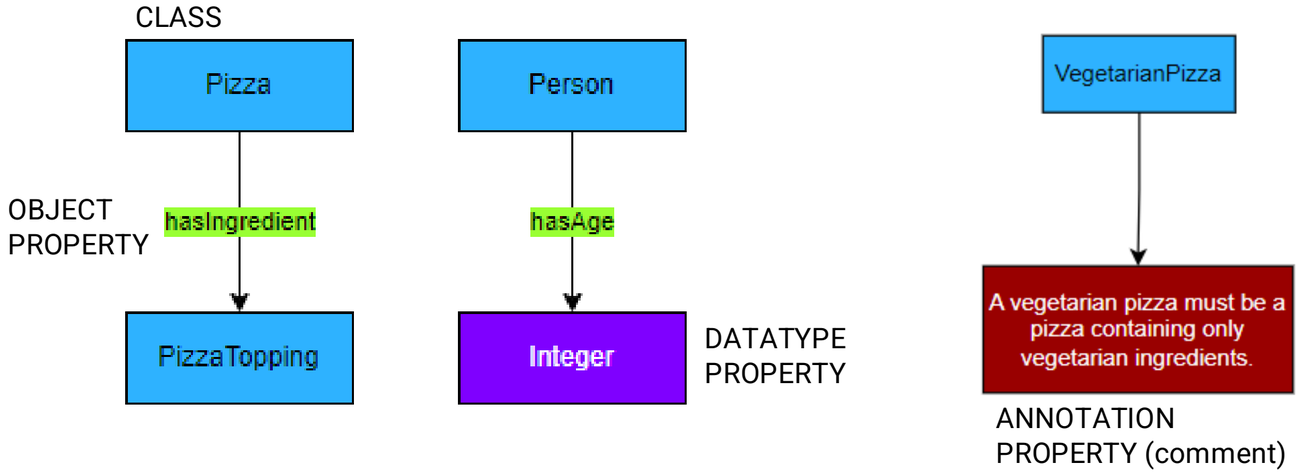
How to create an OWL ontology?

Semantic web approach for built heritage representation

PROPERTIES

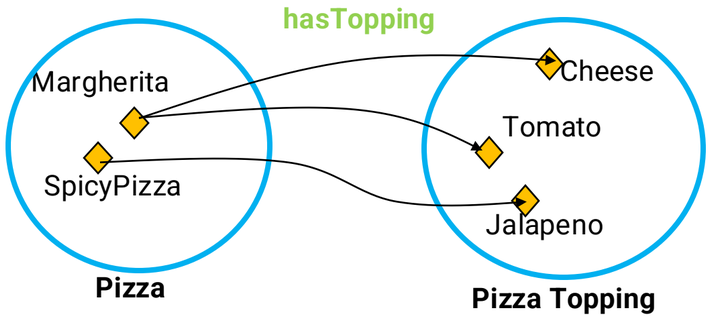
They can be:

- Object properties
- Data properties
- Annotation properties



They can have Domain and Range:

- These define the classes to which the property applies (domain) and the types of values or classes it relates to (range).
- They are optional, but recommended for detecting inconsistencies.



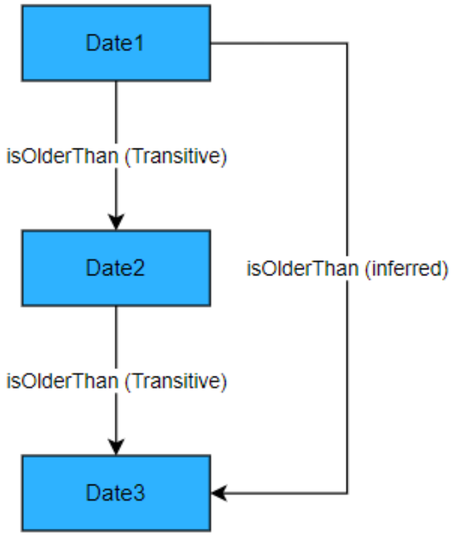
How to create an OWL ontology?

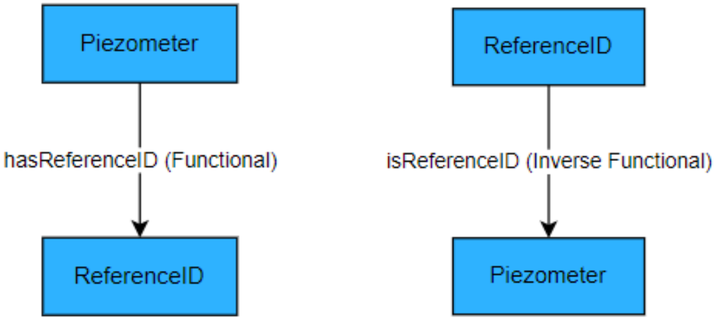
Semantic web approach for built heritage representation

PROPERTIES

They can have several characteristics:

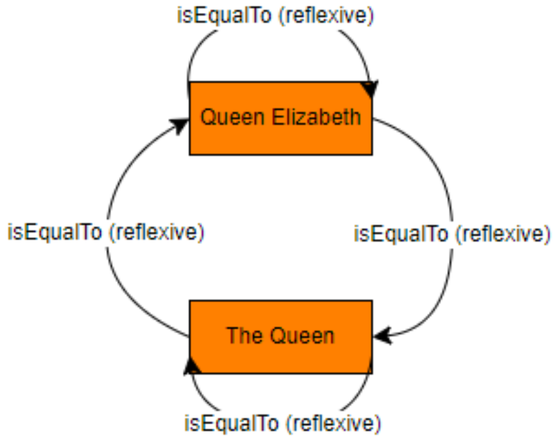
- Functional
- Inverse Functional
- Transitive
- Symmetric
- Asymmetric
- Reflexive
- Irreflexive





They can have several restrictions:

- Existential restrictions
- Universal restrictions
- Cardinality restrictions
- hasValue restrictions



Restriction types		
∃	Existential, someValuesFrom	“some”, “at least one”
∀	Universal, allValuesFrom	“only”
∋	hasValue	“equals x”
=	Cardinality	“exactly n”
≤	Max Cardinality	“at most n”
≥	Min Cardinality	“at least n”

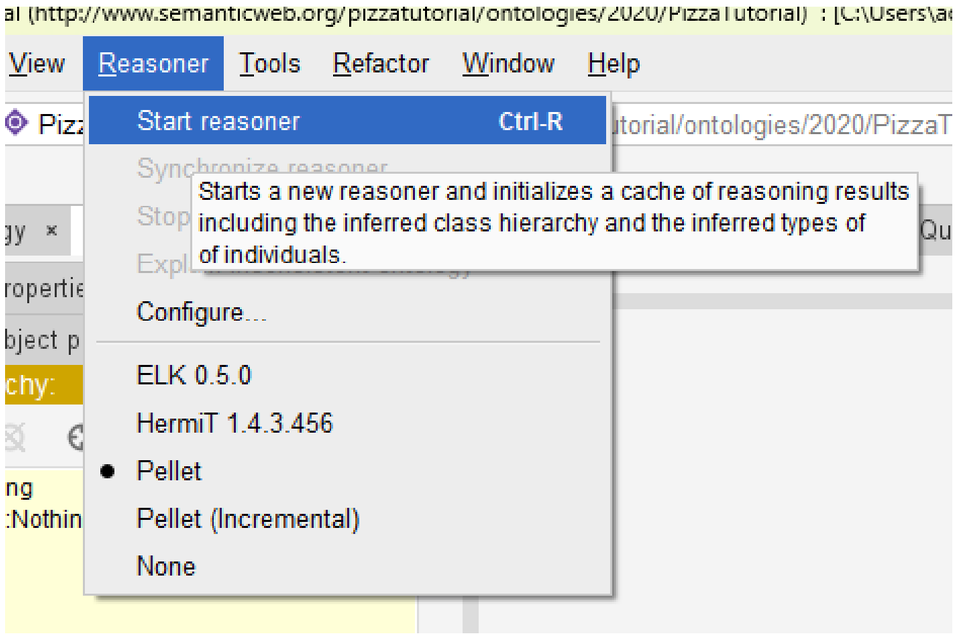
Restrictions = Axioms (in OWL)

Knowledge-Based Reasoning

Semantic web approach for built heritage representation

REASONERS

- An OWL ontology allows the use of a reasoner.
- A reasoner is a tool that enables reasoning, which is the process of concluding, making inferences or arriving at a decision based on available information, knowledge and logic.
- Its use will also allow ontology validation by detecting inconsistencies and subsumption relationships between classes.
- Only Protégé Desktop software contains this functionality (the online version does not).



Knowledge-Based Reasoning

Semantic web approach for built heritage representation

SWRL – SEMANTIC WEB RULE LANGUAGE

Information_Object(?i0) ∧ **Age_Attribute_Assigment**(?a1) ∧ **InformationObjInterpretedAge**(?i0, ?ageInterpreted1) ∧ **provides_information_for**(?i0, ?a1) → **AttributeAssInterpretedAge**(?a1, ?ageInterpreted1)

((...) (omissis)

Artifact_Entity(?w1) ∧ Artifact_Entity(?w2) ∧ differentFrom(?w1, ?w2) ∧ Age_Attribute_Assignment(?a1) ∧ Age_Attribute_Assignment(?a2) ∧ differentFrom(?a1, ?a2) ∧ applied_to(?a1, ?w1) ∧ applied_to(?a2, ?w1) ∧ AttributeAssInterpretedAge(?a1, ?age1) ∧ AttributeAssInterpretedAge(?a2, ?age2) ∧ swrlb:notEqual(?age1, ?age2) → Interpreted_Age_Incoherence(?w1, true) ∧ ErrorChecking (?w1,"The verification reported the presence of inconsistent interpreted dating attributed to the object")

((...) (omissis)

Artifact_Entity(?w1) ∧ Interpreted_Age_Incoherence(?w1, false) ∧ Age_Attribute_Assignment(?a1) ∧ AttributeAssInterpretedAge(?a1, ?Age1) ∧ applied_to(?a1, ?w1) → ArtifactInterpretedAge(?w1, ?Age1)

((...) (omissis)

Artifact_Entity (?w1) ∧ ArtifactCronologicalAge (?w1,?a1) ∧ ArtifactInterpretedAge (?w1,?a2) ∧ swrlb:notEqual(?a1,?a2) → ArtifactAgeIncoherence (?w1,true) ∧ ErrorChecking (?w1,"The verification reported the presence of incoherence between chronological and interpreted dating attributed to the object")

((...) (omissis)

Artifact_Entity(?w1) ∧ ArtifactCronologicalAge(?w1, ?a1) ∧ ArtifactInterpretedAge(?w1, ?a2) ∧ swrlb:equal(?a1, ?a2) → ArtifactAgeIncoherence(?w1, false) ∧ ArtifactAge(?w1, ?a1)

((...) (omissis)

ACTION TO VERIFY THE RELATIONSHIPS OF THE HARRIS MATRIX.

Retrieves the datatype related to dating from the Information_Object class produced by an actor-led interpretation task

Checks and reports the presence of different Interpreted_Age values assigned to the same object

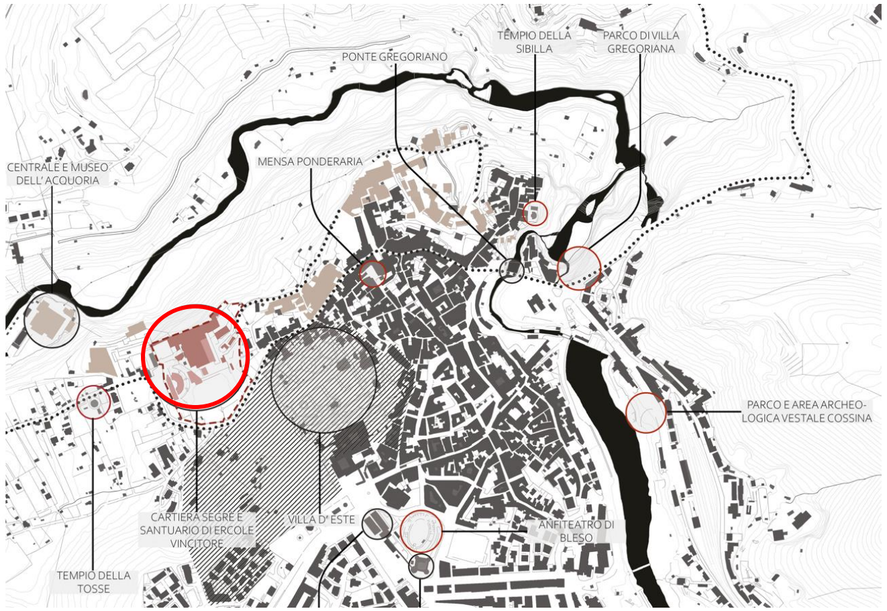
If several interprretative Attribute_Assigment activities related to the same object are congruent, then the dating is assigned to the Interpreted_Age property of the instance. The same actions are performed for different chronological dates assigned to the objects (omitted).

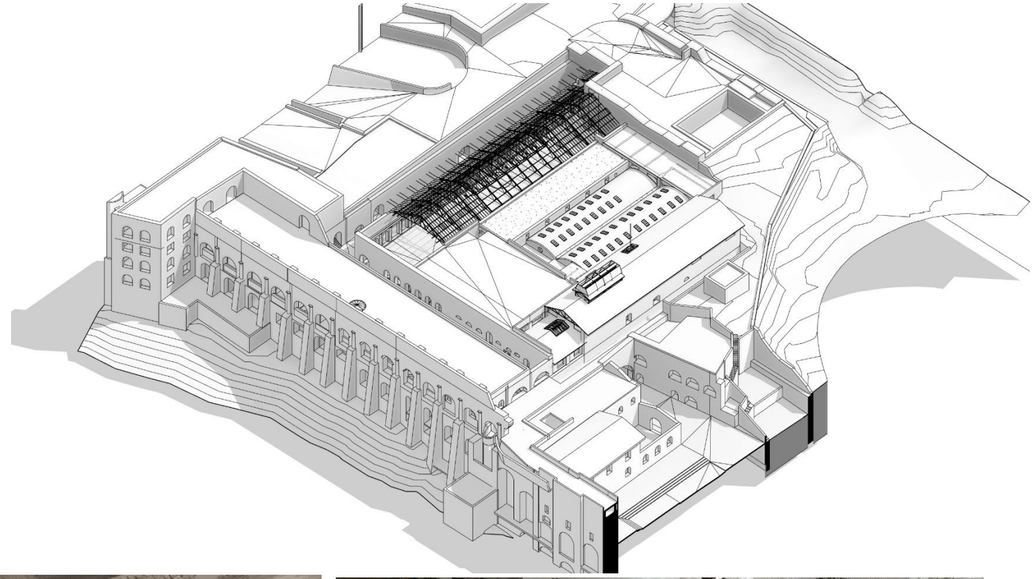
To complete the reasoning process, the verification of consistency between the possible interpreted and chronological dating assigned to it is carried out.

*CURSI S (2021). Un modello di conoscenza per la rappresentazione del patrimonio costruito. Roma:Istituto Armando Curcio, University Press, ISBN: 979-12-80760-02-9

Case study and issues

Semantic web approach for built heritage representation





Triporticus Area

Paper storage room

Hollander Machines room

Case Study - The Sanctuary of Hercules

Semantic web approach for built heritage representation

CASE STUDY AND ISSUES

Classical and Industrial Archaeologies

Context definition

Integrated survey through Digital survey (Low-altitude UAV) and Close-range terrestrial)
Manual survey
Historical and archival research

KNOWLEDGE-BASED SYSTEM

HBIM modelling:
Cloud conversion
Cloud import
Informative modelling

Knowledge base: Requirements Specification
Knowledge domain definition
Existing ontology reuse
Development of missing entities and relations in the domains of interest
Linking data

INTEGRATING WITH INFORMATIVE MODEL

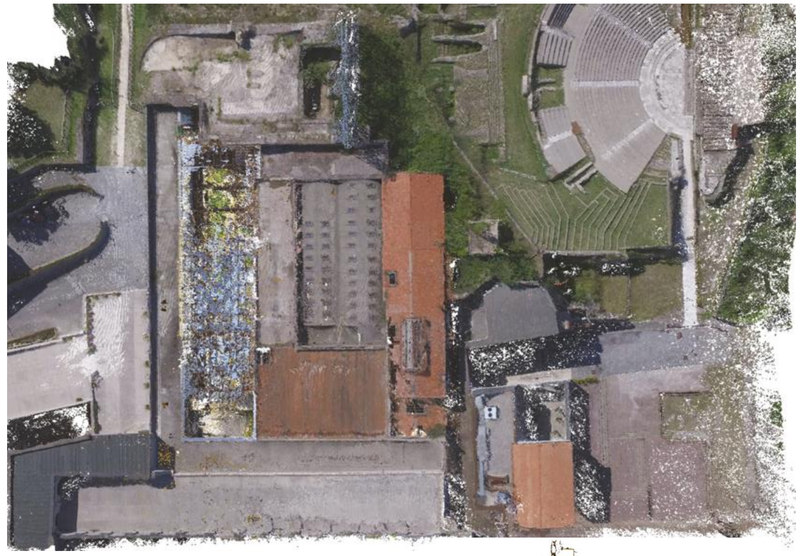
Two example of label correspondence:
Label correspondence between the IFC Space class in the model and the IFC Space class in the knowledge base

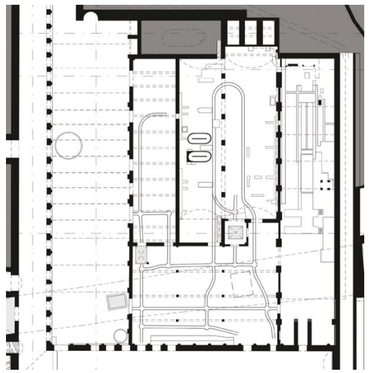
Label correspondence between the building elements from the model and the knowledge base

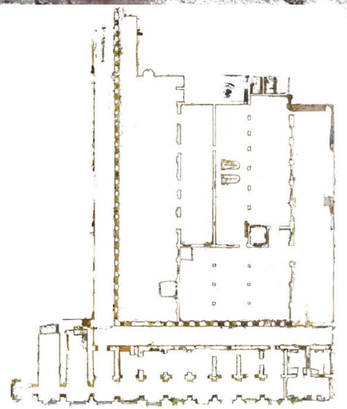
Case study and issues

Semantic web approach for built heritage representation

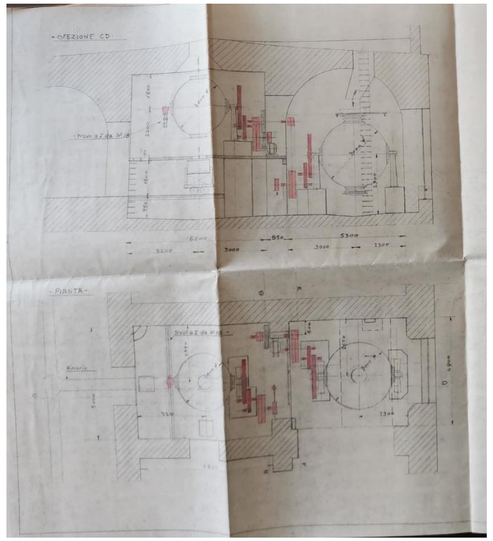
Data from integrated survey

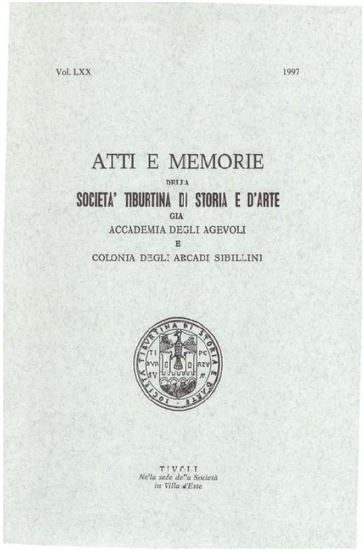


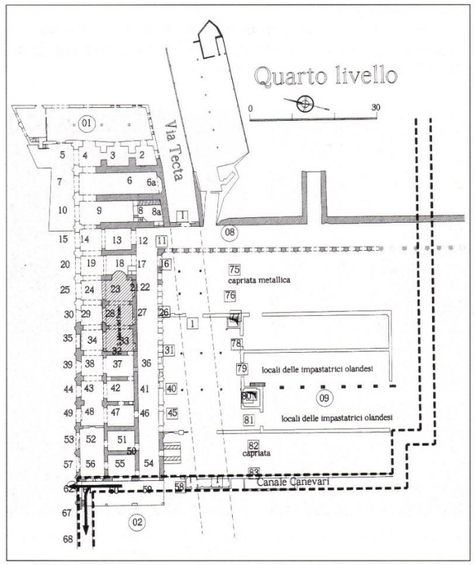


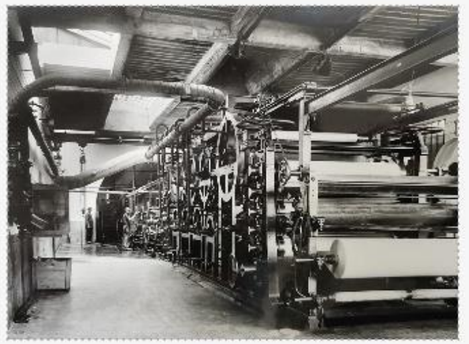


Data from historical and archival research (multiple formats and sources)



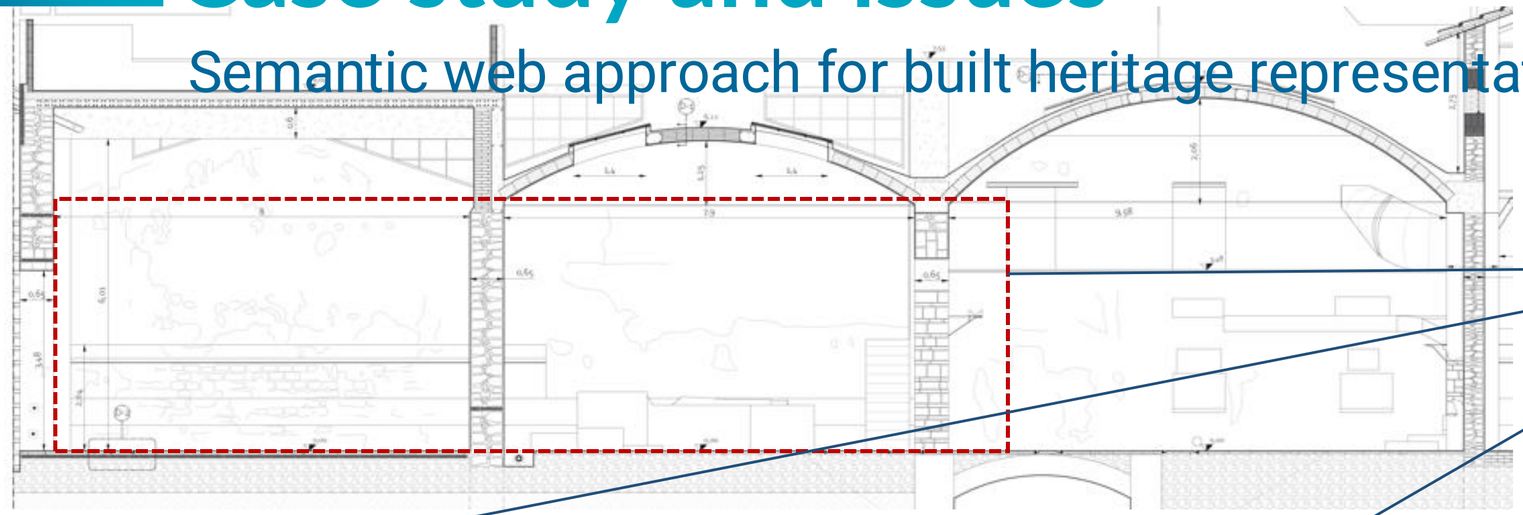






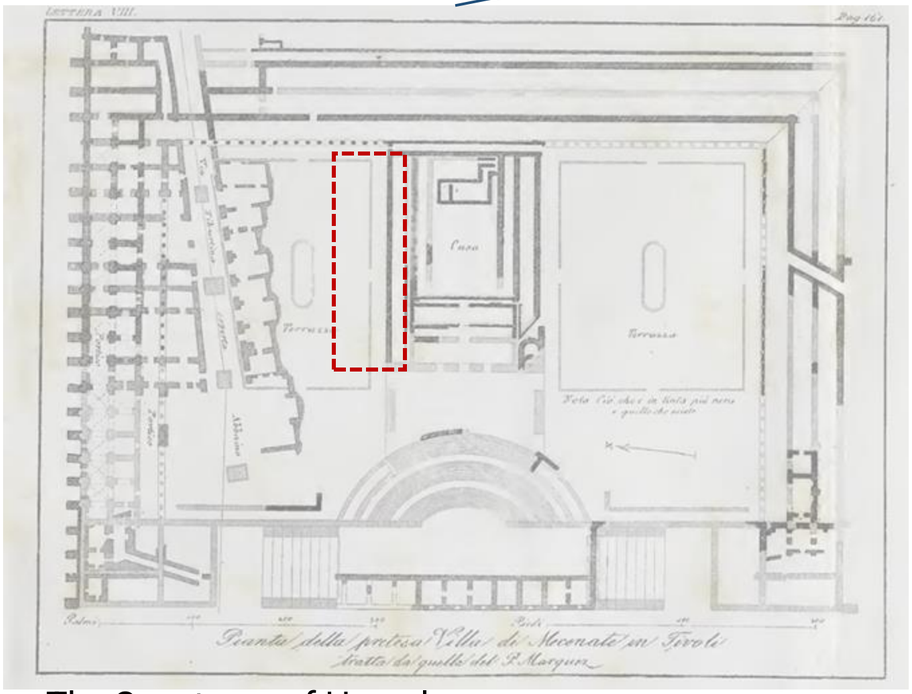
Case study and issues

Semantic web approach for built heritage representation

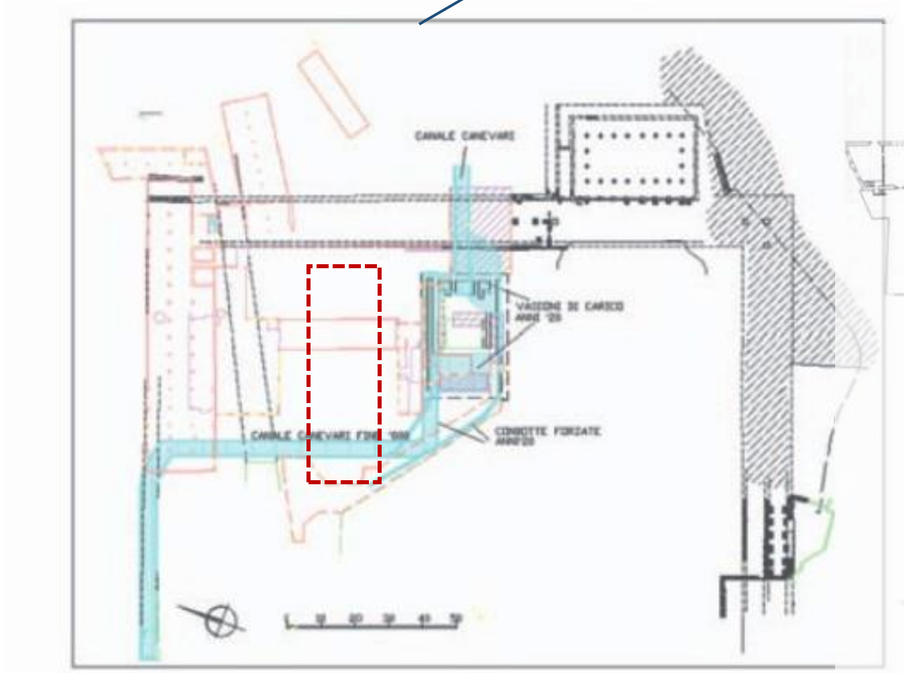


?

Multiple interpretative options



The Sanctuary of Hercules

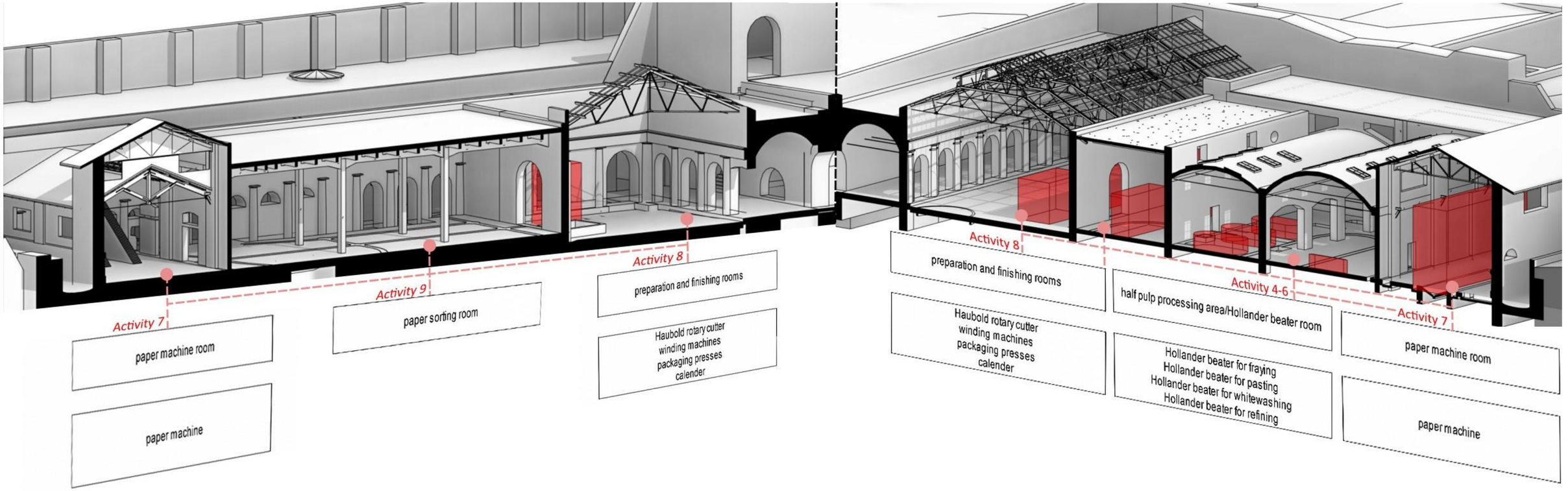


Hydraulic and canal construction

Papermill construction

Case study – knowledge based system

Semantic web approach for built heritage representation



Case study – knowledge based system

Semantic web approach for built heritage representation

1. SCOPE AND STAKEHOLDERS
2. FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS
3. DOMAINS OF INTERESTS
4. EXISTING ONTOLOGIES SELECTION
5. EXISTING ONTOLOGIES INTEGRATION
6. DATA SOURCES (INFORMATION CARRIER)
7. DATA COLLECTION AND PRELIMINARY DATA STRUCTURING
8. ONTOLOGY INSTANTIATION PROCESS
9. INTERPRETATIVE PROCESS REPRESENTATION

FROM DATA COLLECTION TO THE KNOWLEDGE MODEL

1. SCOPE AND STAKEHOLDERS

Scope
Documentation of industrial archaeology in complex and layered historical sites to aid the interpretation activity

Stakeholders
Heritage Conservationists (specialists). Needs: Accurate, comprehensive data; tools for documenting and tracking conservation efforts.
Researchers. Needs: Access to detailed, queryable data; tools for data analysis and visualization; ability to link and integrate with external datasets.
IT and System Administrators. Needs: Robust, secure, and scalable system architecture; tools for system monitoring and management.

2. FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

	General requirements
GReq-01	Data integration and Management
GReq-02	Querying and Retrieval
GReq-03	Visualization and Interaction
GReq-04	Data Linking and Interoperability
GReq-05	User management and Access Control
GnFReq-01	Scalability
GnFReq-02	Performance
GnFReq-03	Usability
GnFReq-04	Reliability and Availability
GnFReq-05	Compliance
GnFReq-06	Interoperability
GnFReq-07	Flexibility and Extensibility

Specific requirements	Industrial Archaeology	Specific requirements	Architectural Artefact
Req-IA-1	Description of identifying features	**Req-AA-1**	Topology of the architectural artefact
Req-IA-2	Identification of past uses and current use	**Req-AA-2**	Classification of building components
Req-IA-3	Definition of historical data with cataloging of different types of sources	**Req-AA-3**	Zone classification
Req-IA-4	Classification of the present/past machinery and the production process	**Req-AA-4**	Classification of building materials
Req-IA-5	Identification of relationships with context and system (whether it can be considered part of a larger industrial system)	**Req-AA-5**	Identification of quantitative and qualitative properties of construction zones, components, and materials
Req-IA-6	Definition of the tangible and intangible aspects that contribute to the recognition of the values of this specific type of heritage	**Req-AA-6**	Linking with different geometric formats and different descriptions for the same component
Req-IA-7	Outlining a classification system for content description	**Req-AA-7**	Outlining a classification system for content description
Req-IA-8	Alignment of the content of terminologies according to different types of classification systems	**Req-AA-8**	Alignment of the content of terminologies according to different types of classification systems

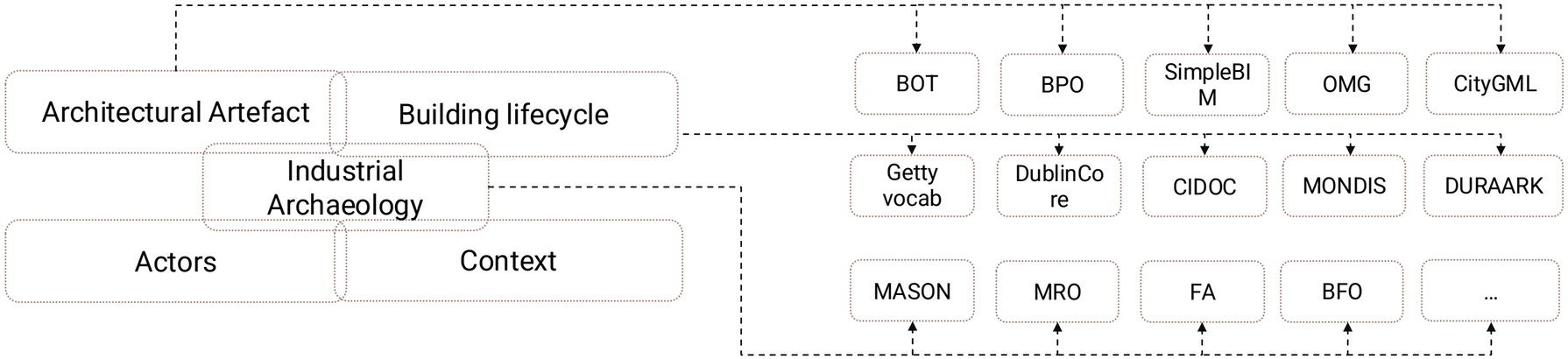
Case study – knowledge based system

Semantic web approach for built heritage representation

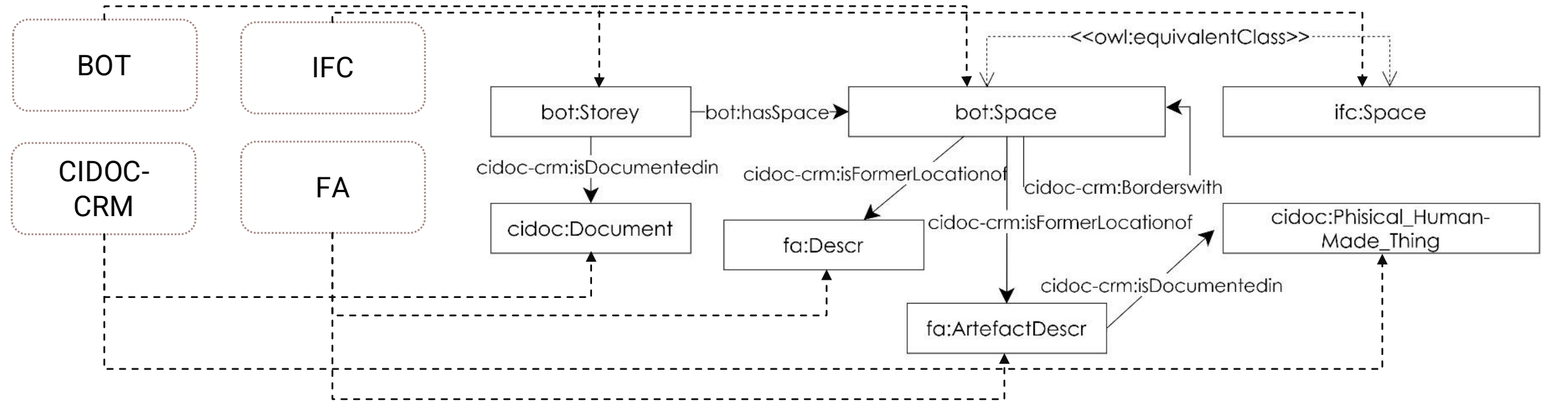
FROM DATA COLLECTION TO THE KNOWLEDGE MODEL

3. DOMAINS OF INTERESTS

4. EXISTING ONTOLOGIES



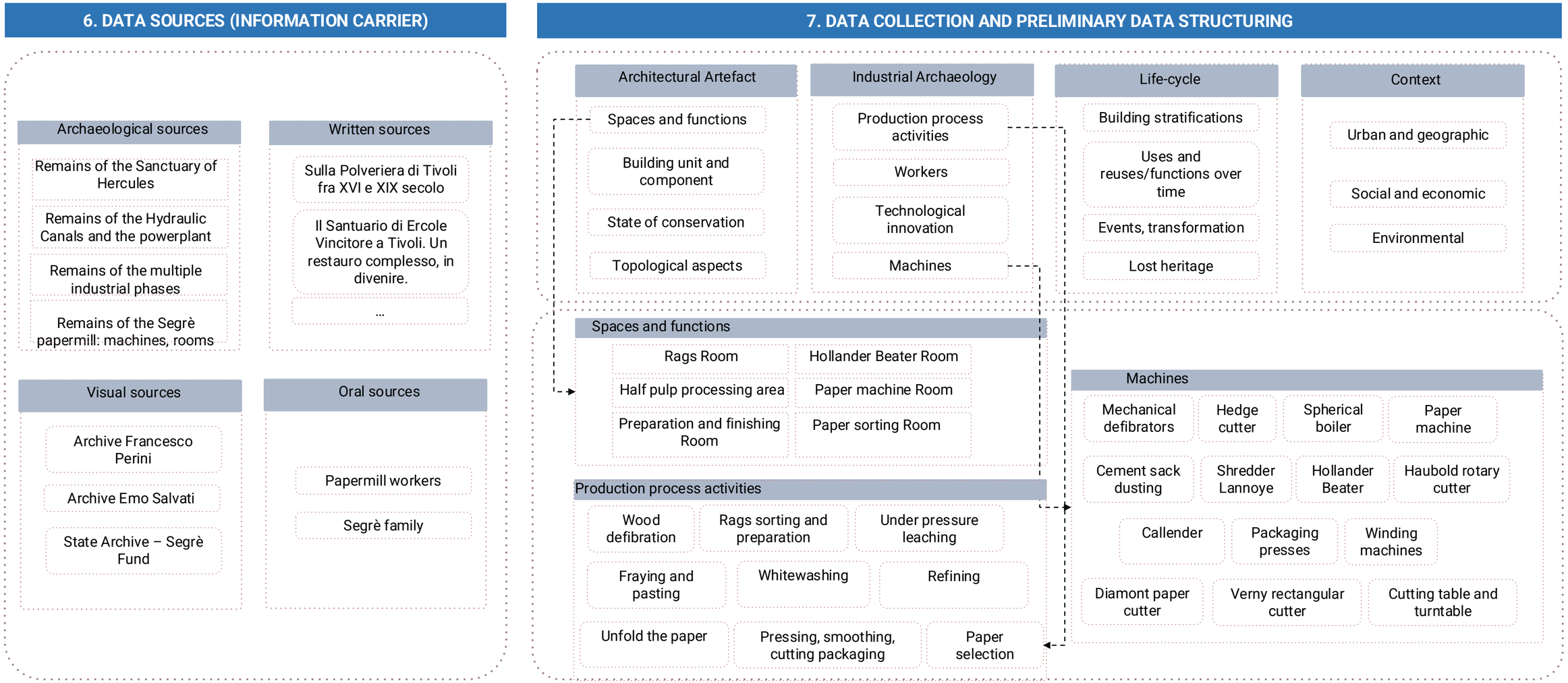
5. EXISTING ONTOLOGY INTEGRATION



Case study – knowledge based system

Semantic web approach for built heritage representation

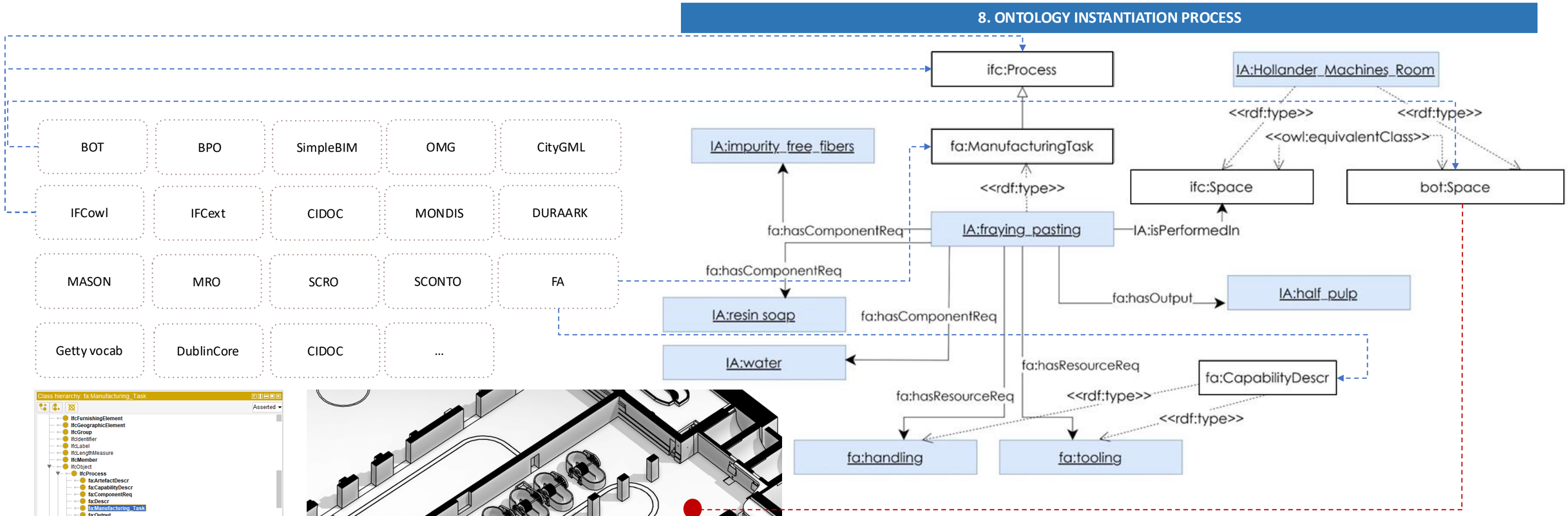
DATA COLLECTION AND ORCHESTRATION

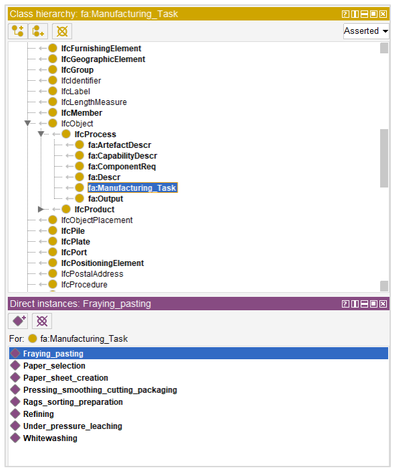


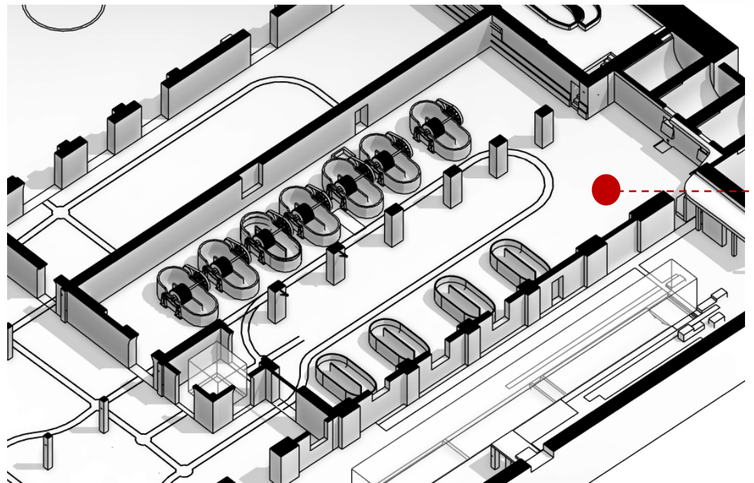
Case study – knowledge based system

Semantic web approach for built heritage representation

KNOWLEDGE INTERSECTION: INDUSTRIAL PROCESSES AND ARCHITECTURAL ARTEFACT







Industrial Standard

ISO 15531_1; Industrial Manifacturing managment data part 1

IEC 62264; Enterprise control system integration. Models and terminology.

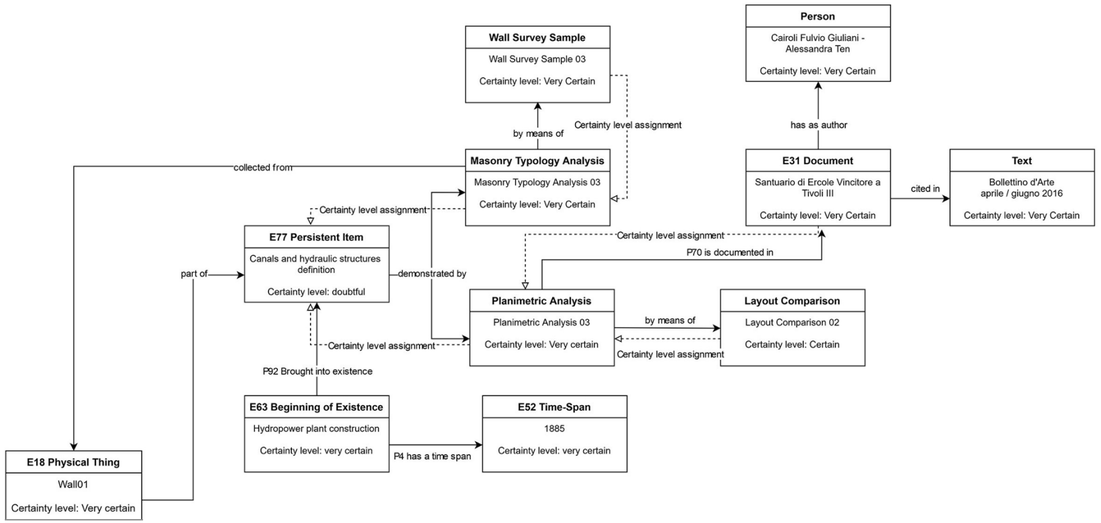
ISO 20534; Formal semantic models for the configuration of global production network

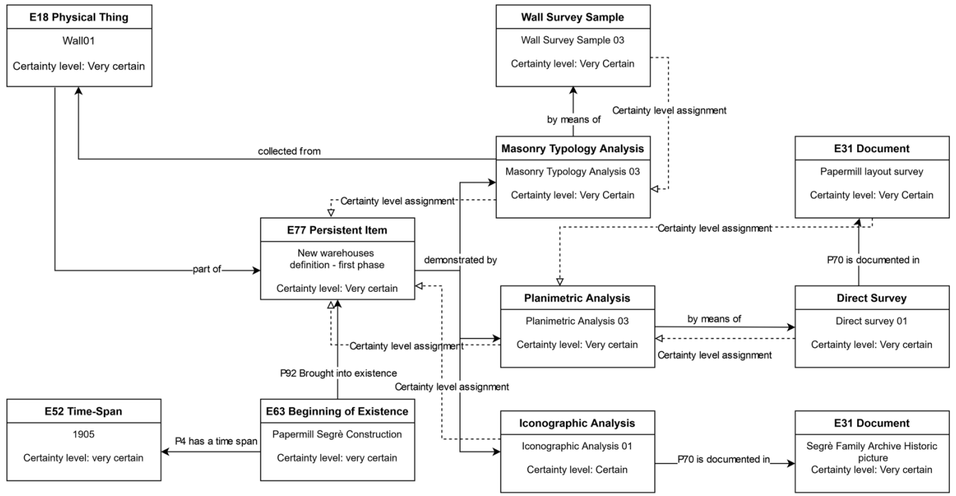
ISO 16739; Industry Foundation Classes

Case study – knowledge based system

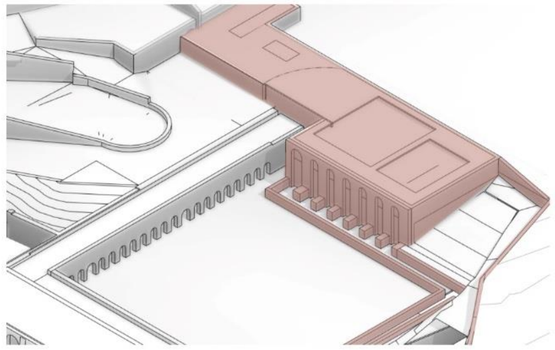
Semantic web approach for built heritage representation

9. INTERPRETATIVE PROCESS REPRESENTATION





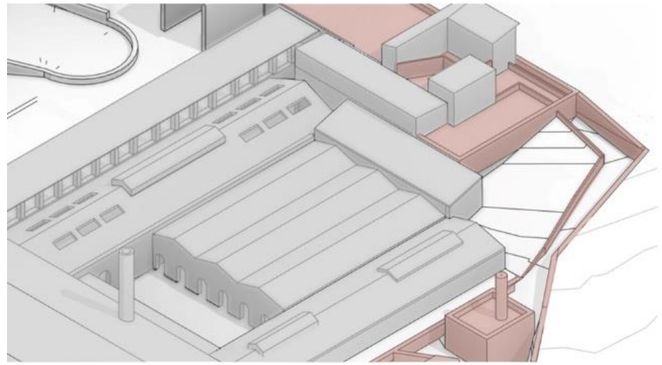
Canals and hydraulic structures (Hydroelectric Power Plant and Canevari Canals construction)



Previous phase

Actual phase

First industrial Phase of the Segrè Papermill (early 1900s)



First industrial phase

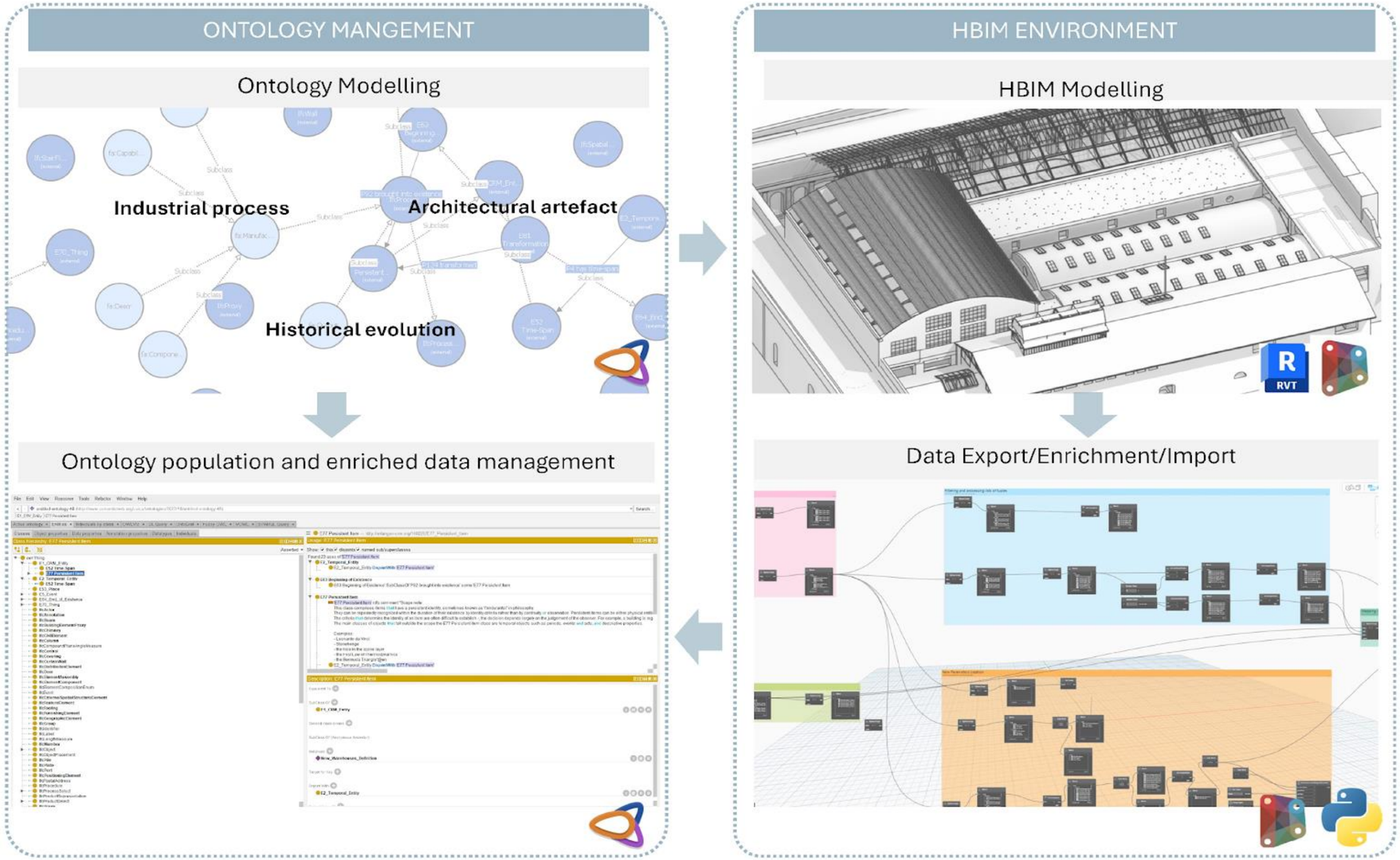
Hydroelectric power plant construction phase

very certain certain doubtful very doubtful unknown

*C.D.L. Cui, S. Cursi, D. Simeone, A. Fioravanti, E. Currà (2024). An Ontology-Driven Approach for Geometry Segmentation and Interpretation in Architectural Heritage/archaeology. In: Data-Driven Intelligence, Proceedings of the 42nd Education and Research in Computer Aided Architectural Design in Europe (eCAADe 2024), Volume 2, pp. 239-248. Nicosia, Cyprus, ISBN: 9789491207389

Case study – integrating with informative model

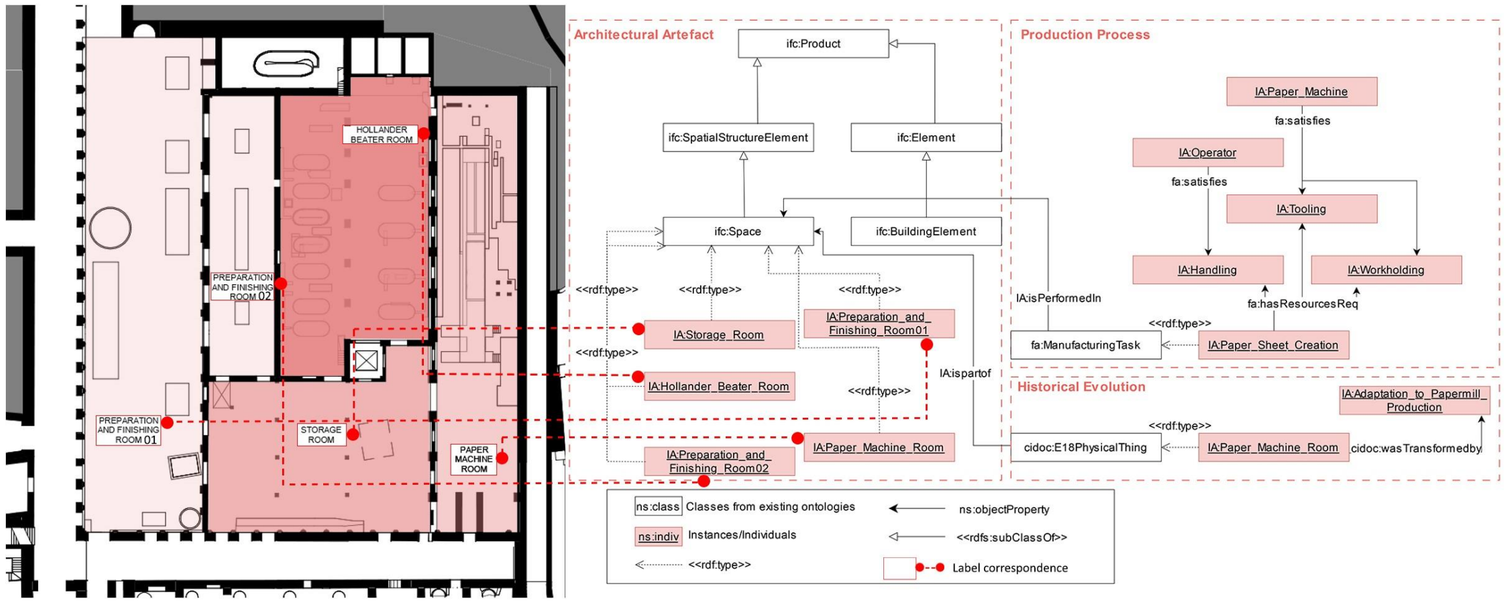
Semantic web approach for built heritage representation



*C.D.L. Cui, S. Cursi, D. Simeone, A. Fioravanti, E. Currà. Industrial archaeologies of complex palimpsests. Application of semantic web technologies to digitalise the knowledge path from data to interpretation, Springer series. “Lecture Notes in Civil Engineering” (https://www.springer.com/series/15087).

Case study – integrating with informative model

Semantic web approach for built heritage representation



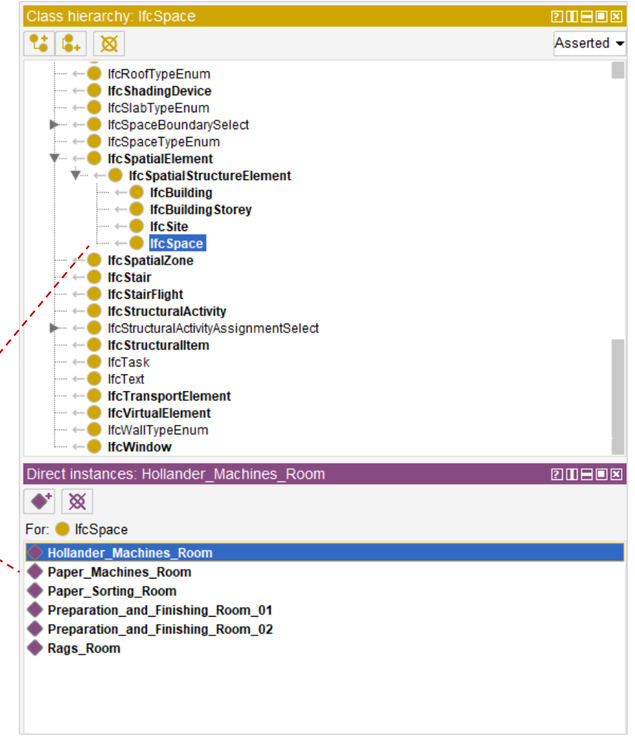
Example of Label correspondence between the informative model and the knowledge base through the instances of ifc:Space

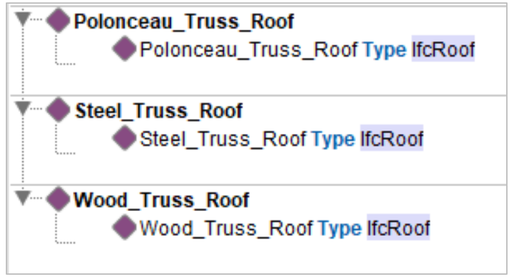
Schema from Protègè – instantiation process

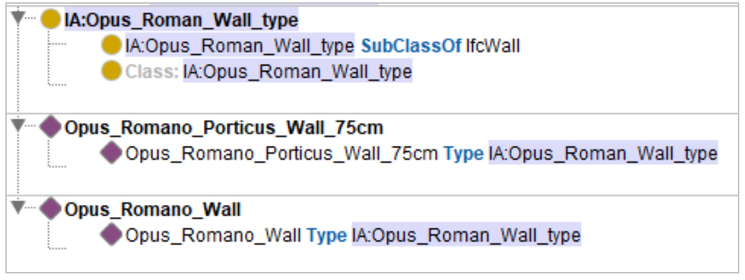
Quote	
Area	877.679 m²
Perimetro	160.2313 m
Altezza non delimitata	4.0000 m
Volume	Non calcolato
Altezza di calcolo	0.0000 m
Dati identità	
Numero	6
Nome	Preparation_and_Finishing_...
Immagine	Preparation_and_Finishin...
Commenti	Lavoro meccanico svolto d...
Occupazione	Impacchettamento carta
Reparto	Finitura carta
Tipo di finitura della b...	
Tipo di finitura del co...	
Tipo di finitura del mu...	
Tipo di finitura del pa...	
Occupant	Operaio Cartiera Segrè
Fasi	
Fase	Esistente
Parametri IFC	
Esporta in IFC	Per tipo
Esporta in formato IFC...	IfcSpace
Tipo IFC predefinito	INTERNAL
IfcGUID	0yrSYxS0LATwtDbyRGjVHM

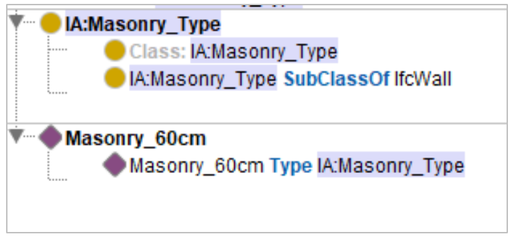
Quote	
Area	548.955 m²
Perimetro	108.7871 m
Altezza non delimitata	4.0000 m
Volume	Non calcolato
Altezza di calcolo	0.0000 m
Dati identità	
Numero	7
Nome	Hollander_Machines_Room
Immagine	Hollander_Machines_Roo...
Commenti	Lavoro meccanico svolto d...
Occupazione	Vasche olandesi
Reparto	Produzione della pasta
Tipo di finitura della b...	Pavimento industriale
Tipo di finitura del co...	
Tipo di finitura del mu...	Muro in tufo
Tipo di finitura del pa...	
Occupant	Operaio Cartiera Segrè
Fasi	
Fase	Esistente
Parametri IFC	
Esporta in IFC	Per tipo
Esporta in formato IFC...	IfcSpace
Tipo IFC predefinito	INTERNAL
IfcGUID	3Dz$$GE55B8BhNyZuiO1rq

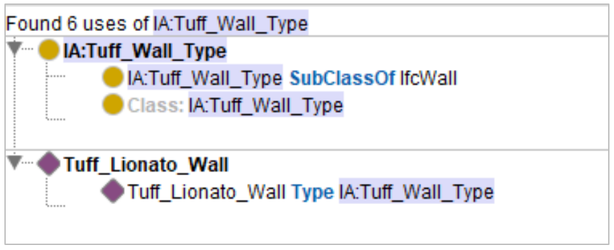
Quote	
Area	512.039 m²
Perimetro	146.0043 m
Altezza non delimitata	4.0000 m
Volume	Non calcolato
Altezza di calcolo	0.0000 m
Dati identità	
Numero	5
Nome	Paper_Machines_Room
Immagine	Paper_Machine_Room.png
Commenti	Lavoro meccanico svolto d...
Occupazione	Macchina continua - Operaio
Reparto	Produzione della carta
Tipo di finitura della b...	Pavimento industriale
Tipo di finitura del co...	
Tipo di finitura del mu...	Muro in tufo - opus incertum
Tipo di finitura del pa...	
Occupant	Operaio Cartiera Segrè
Fasi	
Fase	Esistente
Parametri IFC	
Esporta in IFC	Per tipo
Esporta in formato IFC...	IfcSpace
Tipo IFC predefinito	INTERNAL
IfcGUID	0yrSYxS0LATwtDbyRGjVHx

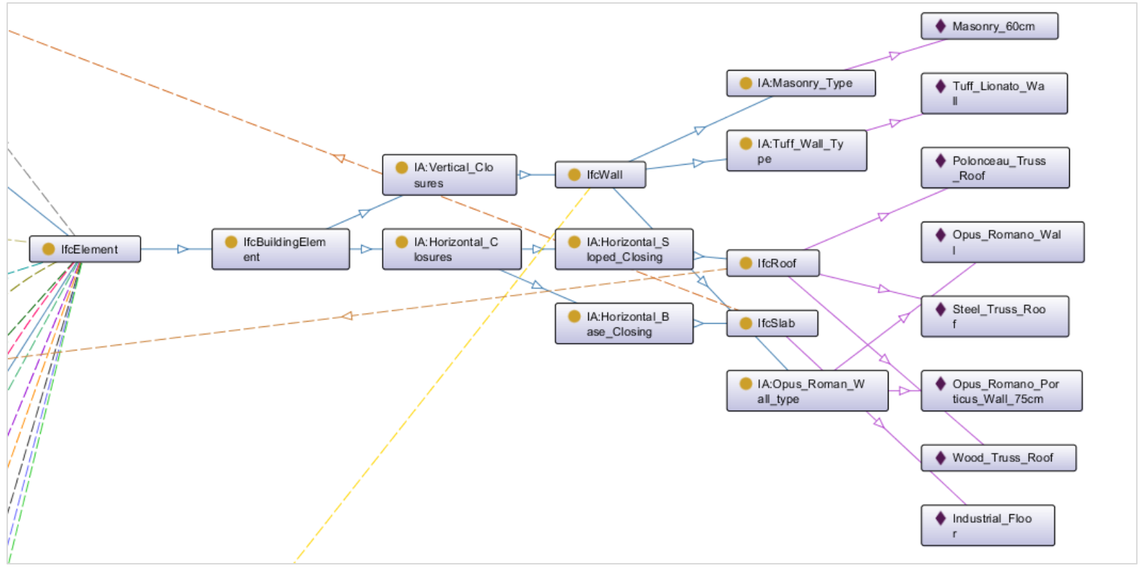






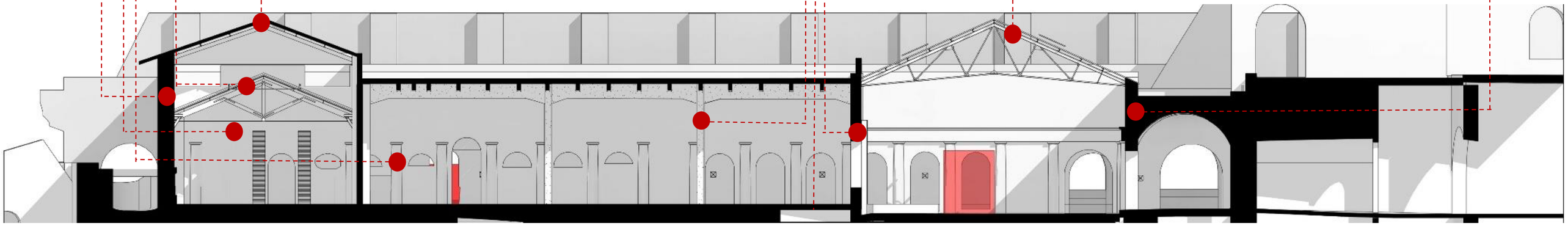






	IFCGUID	Esporta in formato IFC
Tuff_Lionato_Wall	20y91n3or7ZxDmOVLcX3XP	IfcWall
Opus_Romano_Wall	0otr0kP0bFk9IG6ECVRoJh	IfcWall
Doric_Column	0FhjV$ta90pv5VEY3Sbj6G	IfcColumn
Wood_Truss_Roof	3E7vCsOjv8BuKW6OSi0Zm4	IfcRoof
Steel_Truss_Roof	0L8p1DNUj8_hxJ9GwFFnYC	IfcRoof

	IFCGUID	Esporta in formato IFC
Concrete_Pilaster_38x38cm	0AoCpqrWLFTRvmmwQgkN85	IfcColumn
Industrial_Floor_30cm	0FcD2TDfDBGvMBBVfrBLvv	IfcSlab
Masonry_60cm	34$$klyJv6mR7k4ztpZiir	IfcWall
Opus_Romanus_Porticus_75cm	2vesht1PjCpB_FlliFn$$7	IfcWall
Polonceau_Truss_Roof	0MndzfoN53TBzXNBou2008	IfcRoof



HBIM and Semantic Web challanges

Semantic web approach for built heritage representation

- Work on different types of information granularity, **from general to specific**
- **Overcome the rigidity of the parametric model** which clashes with the heritage assets representations
- **Implementation** and **queries** activities
- **Defining and managing** imprecise and **uncertain data** in the interpretation process to address the three main issues related to a general knowledge dilemma

Thanks for your attention!

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