# TDH022 – TECHNICAL INTEROPERABILITY GUIDELINES AND API MANAGEMENT

## Operative Document

## Ontologies

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# CHAPTER 1 – INTRODUCTION AND REFERENCE CONTEXT

As written in the document "Guidelines on technical interoperability and API management", the Ministry of Tourism, supported by ENIT - National Tourism Agency, has the task of coordinating the entire Italian tourism ecosystem, promoting, in a unified way, the relaunch of the tourism sector through a cohesive and heterogeneous information and service offer, in the face of continuous changes in national and international demand.

The purpose of the TDH initiative is the re-launch of Italia.it, enriched with new internally produced content and in partnership with Regions and Autonomous Provinces, but also through integrations with partners in Tourism. In detail, for each topic discussed, the website will offer content with a triple relevance:

- **Content of Interest**: **editorial content, which enables the TDH to infer the Person's interest when reading it.** It enables the description of one or more destinations, one or more offers and/or any type of event related to the tourist experience in our territory (e.g.: an editorial article that talks about the Palio of Siena, if read by the tourist, suggests interest for Siena and its historical pageants);

- **Destination**: **local attraction related to a point of interest** (x, y coordinates) **or to a geographical area** ("geometry") **that persists in the medium-long term** (e.g., Colosseum, Trevi Fountain, the city of Rome, etc.);

- **Offer**: a touristic item that **can be consumed/booked/seen for a fee** (e.g., a hotel room, a museum entry).

TDH also aims at making the tourist market demand towards Italy profitably meeting the related Italian offer (provided by different actors), by connecting the individual's (tourist) interests, destinations and offer before, during and after the tourism experience, creating value for all stakeholders involved.
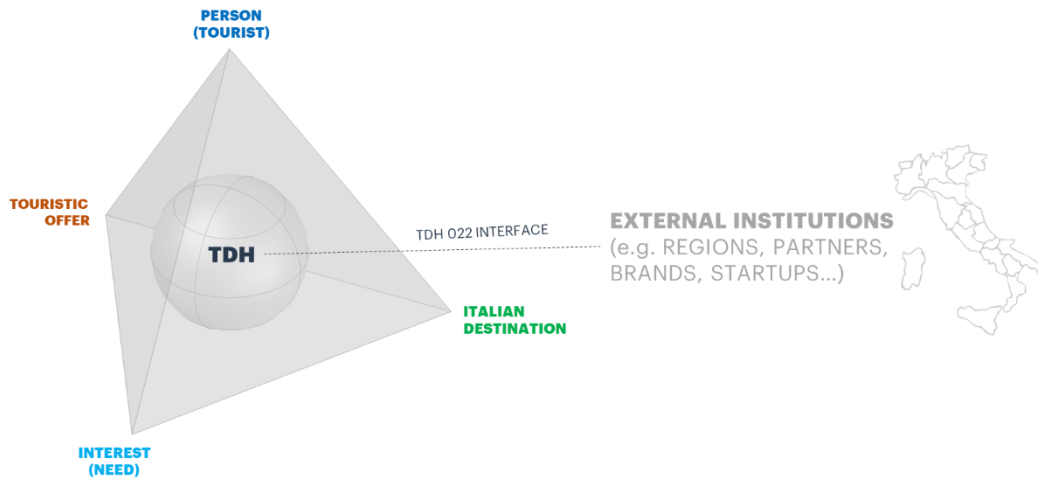
*Figure 1 - TDH ecosystem and external connection through TDH022*

# CHAPTER 2 – ONTOLOGIES: SHARING KNOWLEDGE

Ontologies represent a formal instrument of representation of one or more specific domains of knowledge. The objective of the document is the sharing of knowledge, the description of the semantics of the data through an agreed terminology, as well as documenting the progressive evolution of the ontology of the touristic domain.



*Figure 2 – The role of ontologies on Content of Interest – Offer – Destination Relationship*

As shown in Figure 2 above, the fundamental role of ontologies for the purposes of representation and organization of data contained within the various domains is immediately denoted.

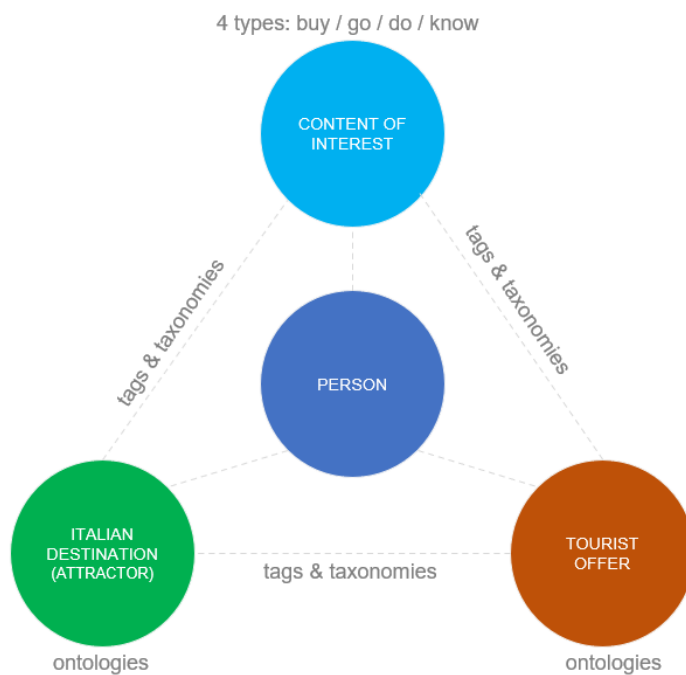# CHAPTER 3 – REFERENCES AND ABBREVIATIONS

## 3.1 Terms and definitions

For easier reading, a glossary of terms and acronyms contained in the document is provided:

| | |
|---|---|
| **[AgID]** | Digital Agency for Italy |
| **[API]** | Application Programming Interface |
| **[ETL]** | Extraction, Transformation and Load |
| **[HTML]** | Hyper Text Mark-up Language |
| **[OWL]** | Ontology Web Language |
| **[POI]** | Point of Interest |
| **[POS]** | Point of Sales |
| **[RDF]** | Resource Description Framework |
| **[SPARQL]** | RDF Query language |
| **[TDH]** | Tourism Digital Hub |
| **[TDH022]** | TDH022 - Interoperability interface of the Tourism Digital Hub |
| **[W3C]** | World Wide Web Consortium |

# CHAPTER 4 – ELEMENTS OF ONTOLOGICAL STRUCTURE

## 4.1 Definition of ontologies

An ontology is defined as a formal and explicit specification of shared representation of a knowledge domain, defined based on specific requirements.

Another important concept is represented by the "Classes of an ontology"; for the tourism sector, classes are the explicit formal description of concepts (they can contain terms such as "hotel" or "museum"). An ontology for the travel domain might contain concepts such as "tourist destination" and "means of transport" and the relationship among them. Instances are typically used to model the elements belonging to classes; for example, the "Duomo Milano" instance belongs to the "Destination" class.

Classes are generally organized in a hierarchy of subclasses, while an ontology linked to a set of individual instances constitutes a knowledge base.

Conversely, properties establish the relationships between the concepts of an ontology: for example, the "isLocatedAt" property associates an object with the place it belongs to. The simplest type of ontologies is called taxonomies and they consist of a hierarchy of classes that represent the relevant concepts in the domain.

Having defined these preliminary concepts, to represent an ontology, it is necessary to follow a certain logical process, shown below:

1.  Classes definition – *e.g.: "apartment"*;

2.  Arrangement of classes in a taxonomic hierarchy (subclass-superclass) – *e.g.: "apartment that is part of a condominium"*;

3.  Definition of properties of classes – *e.g.: "apartment has an address"*;

4.  Description of the values allowed in the entered instances – *e.g.: the civic address is a "number"*.


## 4.2 The controlled vocabulary

A controlled vocabulary is defined as a series of predefined and authorized standard terms and codes, preselected to index and retrieve information.

### 4.3 Classification of ontologies

A very important aspect in the ontology development process is to consider reusing existing ontologies to adapt them to a specific purpose, thus saving a lot of time instead of rewriting a new one. In this sense, and to facilitate the exchange and standardization of data, improve the development of new information systems, and enable the integration of data from different sources, the 'OntoPiA' network of ontologies and controlled vocabularies has been taken into consideration. Currently the network consists of 27 ontologies, one of which imports them all, thus representing the only access point to the overall network: 32 controlled vocabularies and a mapping file between different controlled vocabularies.

The OntoPIA Network is represented as a stack of ontologies, distinguished and classified according to their level of specificity: foundational, core, of support, of domain and of metadata.

### 4.4 Foundational ontologies (Top – Level Ontology, Upper Ontology)

They are foundational concepts[1] common to all domains. They represent very general concepts, that are independent from a domain or a specific concept. An example are space and time.

In these ontologies we have taken the L0 ontology[2] as an example and used *classes*, *object properties* and *data properties*. Among the classes we highlight the *Entity*, defined as any real thing possible and imaginary.

The *Entity* class has as subclasses, for example:

- *Characteristics:* the aspects, attributes, or qualities of an entity;
- *Event or Situation:* any entity that typically flows in time, both in the physical and social world (e.g., atmospheric phenomena, concerts, travels, institutional processes, etc.);
- *Location:* the class representing the concept of place;
- *Collection:* the class including collections of anything (e.g., Groups, collections, communities, etc.);
- *Activity:* the class of activities carried out by any agent;

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[1] Inherent to fundamentals

[2] L0: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/l0

- *Object:* any entity that tends to be stable over a longer or shorter period (e.g., houses, cities, organizations, works of art, etc.);

- *Topic*: the class that includes themes, topics, categories and disciplines such as mathematics, leisure, martial arts, etc.

Among the object properties we point out, for instance:

- *has description:* property that associates an entity with its description (*is description of* is its inverse);

- *has topic*: property that allows the association of an entity to a topic (*is topic of is* its inverse).

## 4.5 Core ontologies

Core ontologies, also called 'core-level' ontologies, are independent of the concepts of vertical domains and can be used to describe transversally multiple concepts. Two ontologies are used as a reference:

- *CPV* referring to people;

- *CLV* referring to address location.

As just introduced, the CPV ontology refers to people; in fact, within the Characteristics category we have three different subclasses relating to the person, which are:

  o *Education Level* referring to the level of education of a person;

  o *Person Status* referring to the title that is inserted before or after the name of the person (e.g., Mr., Dr., Atty.),

  o *Sex* referring to the gender of the person.

The CLV ontology refers to the address location; some of the relevant main classes (mainly used in ontologies relating to destinations and points of interest) are, by way of example, the following:

  o *Address,*

  o *Address Area,*

  o *Address Component,*

  o *City,*

  o *Civic Numbering,*

- o *Geometry,*
- o *Geometry Type,*
- o *Street Toponym.*

## *4.6 Supporting ontologies*

They use the foundational level to define general concepts, which however are not foundational: organizations, communication, physical states, measurement systems to mention a few. They are also called 'mid-level' ontologies and model supporting concepts for other ontologies; these include for example concepts relating to time, roles, units of measurement, prices, points of interest.

Furthermore, these ontologies take as a basis the previous ontologies by adding more details and refer to fundamental concepts related to a specific task or a specific activity. Some examples are POI ontology[3] (Point of Interest ontology), MU[4] (ontology for modelling values and units of measurement), POT[5] (ontology of prices, offers and tickets).

Some examples of classes extracted from supporting ontologies:

- *Point of Interest / Point of Interest Status (POI):* represents the state of the point of interest, arranged according to the type of point of interest: if we refer to a car park we say "free" or "occupied", if we refer to an accommodation facility we say "open", "closed" or " under renovation ", etc.;

- *Offer:* represents the concept of the offer;

- *Measurement Unit, Measure Type e Value:* they refer respectively to the class that is used to represent a measure (e.g., meter, kilogram, gram etc.), the class that represents the type of measure (e.g., length, height, etc.), and the value class;

- *Time Interval (TI):* the representation of the time interval.

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[3] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POI
[4] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/MU
[5] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POT

## 4.7 Domain ontologies

These types of ontologies represent the concepts and relations of a specific domain. For instance, the ACCO ontology[6] (the ontology of the accommodation facilities which will be described in detail in the following chapters) and CPEV[7] (the ontology of public events): both are characterized by greater detail than previous ontologies and explain the terms introduced in top - level ontologies in more depth.

## 4.8 Metadata ontologies

In this category we find the DCAT-AP_IT ontologies for the meta dating of data catalogues; this process relates to the definition of the metadata contained in the data catalogues relating to the ontologies in the JSON-LD, RDF / XML and RDF / Turtle formats.

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[6] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/ACCO
[7] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/CPEV

# CHAPTER 5 – THE MODULAR CREATION PROCESS OF ONTOLOGIES

We now proceed to report the logical process underlying the creation of the ontologies, with relative focus of detail to define its individual parts.

1. **Definition of business requirements** – *Preliminary phase of determining the domain based on the aims and objectives of the research;*

2. **Collection, modelling, and analysis of relevant data and ontologies** – *Data acquisition and analysis of existing ontologies, adapting the collected material to the established domain;*

3. **Creation of the semantic data model and possible integrations through ETL** – *The ontologies (data model) and the collected data allow to build the "Knowledge Graph", through a process of semantic integration; the strategy adopted to apply this process is to adopt reference ontologies as global schemes. The ETL approach, therefore, establishes a repeatable process for extracting relevant content from data sources and updating and integrating the Knowledge Graph accordingly.*

4. **Data harmonization** – *Definition of a common language for data interchange to reunite data of different formats, conventions, vocabularies and names in a homogeneous data set.*

# CHAPTER 6 – DEVELOPMENT OF ONTOLOGIES VIA OWL (ONTOLOGY WEB LANGUAGE)

## 6.1 Basic concepts

The central concept of the ontology is the triplet that relates the "Interest-Destination-Offer" dimensions. To define and instantiate the ontology, the OWL language was used, which in turn includes descriptions of its classes, properties and instances.

The core concept and the three basic concepts / dimensions can be exemplified in the following ways:

*Example of relationship between: Content of Interest, Offer, Destination - Starting from an Interest (in the case of the TDH, an editorial article presents on the regional portals that allows the TDH to infer "the interests of the Person") it is possible to implement a linked Offer to different Destinations*

**CONTENT OF INTEREST**: "The concerts of the famous Italian rockstar"

- *Content of Interest:* The concert of the famous Italian rock star
- *Offer:* Concert tickets
- *Destination:* Concert Hall/Stadium where the event takes place



*Figure 3 – Relationship between Content of Interest - Offer - Destination*

The resultant of this interrelation, specifically, can be declined as: "The concert of the famous rock star in Milan (San Siro Stadium) on February 1, 2022 at 21:30 (price € 70.00)", as well as "The concert of famous rock star in Modena (Braglia Stadium) on February 10, 2022 at 21:00 (price € 65.00) ".

*Example of relationship between: Content of Interest, Destination, Offer - starting from the editorial article (Content of Interest) it is possible, based on an interest in a specific Destination, to structure an ad hoc Offer*

**CONTENT OF INTEREST**: "The beauties of the Sila National Park"

- *Content of Interest:* The beauties of the Sila National Park

- *Destination:* Sila National Park
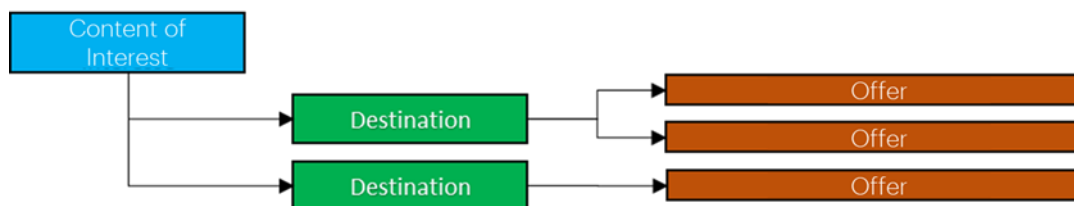
- *Offer:* Park entrance ticket



*Figure 4 – Relationship Content of Interest – Destination – Offer*

The resultant of this interrelation in this case can be declined as: "Visit of the Sila National Park at the Sila National Park on 23 January 2022 at 9:00".

*Example of relationship between: Content of Interest and Offer - based on a Content of Interest on which to structure an Offer that does not require a Destination to support.*

**CONTENT OF INTEREST**: "Food and wine guide"

- *Content of Interest:* The best Italian restaurant guides of 2022

- *Offer:* Food and wine guide

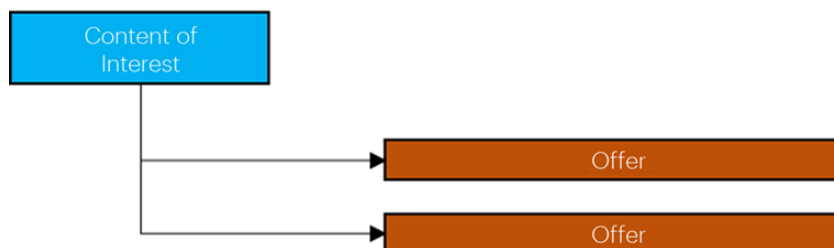- *Example:* "Italian Restaurants of 2022" guide (Price € 22.00)



*Figure 5 – Relationship Content of Interest - Offer*

The resultant of this interrelation in this case can be declined as: "Italian Restaurant Guide of 2022 (price € 22.00)".

## 6.2 The "Content of Interest" dimension

The "Content of Interest" dimension corresponds to the editorial content that allows you to represent destinations, offers or any other event concerning the tourist experience in our territory, in relation to one or more destinations. In the ontology development, an 'Article' class has been arranged for the modelling of the Interest dimension.

The image below (*Figure 6*) shows the high-level scheme relating to the Content of Interest. The Article class, at the centre of the diagram, represents the interest of the user of the article.
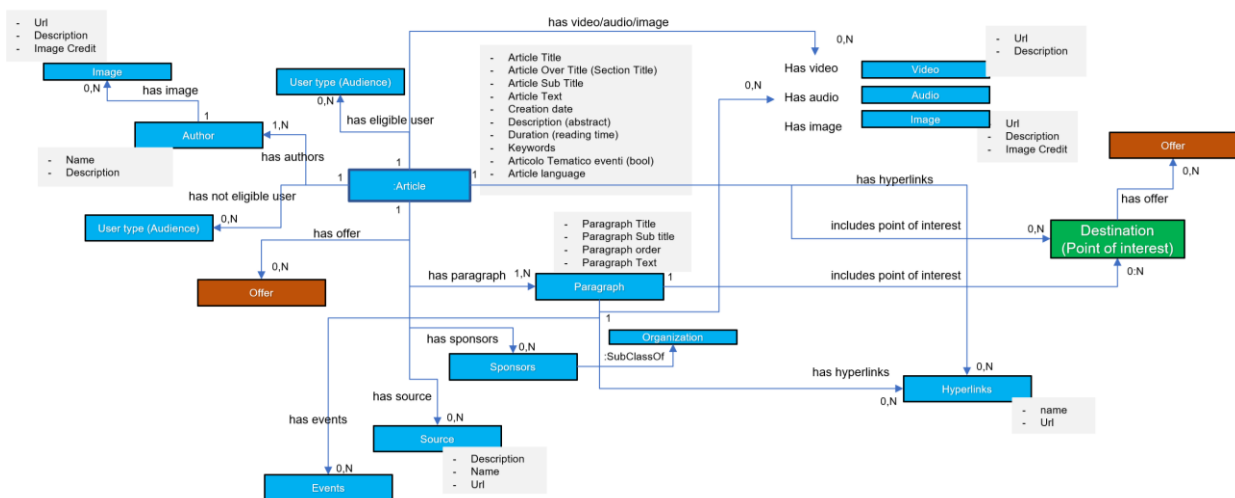


*Figure 6 – High-level scheme of "Content of Interest" dimension*

The other classes used, for the purpose of defining the dimension, were the following:

- *Paragraph (there can be from 1 to N paragraphs):* represents the paragraphs of the article;
- *Events:* the events covered in the article;
- *Destination (PointOfInterest):* de facto a superstructure useful for modelling destinations and points of interest;
- *Video, Audio, Image:* respectively indicate the presence of video, audio or images within the paragraph;

- *Source:* 0 to N resources may be present in the article. This class represents the resources that were used by the author for the composition of the article.

- *Sponsors:* 0 to N sponsors may be present in the article. This class represents the sponsorships of the article. *Organization* is a subclass of *Sponsors;*

- *Authors:* from 1 to N authors may be present in the article, since the presence of at least one author is assumed. This class represents the authors who composed the article. This, in turn, has another class, that is *Image*, referring to the image of the author;

- *User type (Audience):* there may be within the article from 0 to N User Type. This class indicates the presence of an established audience for reading the article (the type of user to whom the article is addressed) or the prohibition of a particular public;

- *Offer:* there may be within the article from 0 to N offers; this class indicates the presence of an offer within the article;

- *Video, Image, Audio:* there may be video, image and audio content within the article and the paragraph from 0 to N;

- *Hyperlinks:* they may be present within the article and within the paragraph from 0 to N hyperlinks; this class represents hyperlinks.

The following object properties were used:

- *Has authors:* this property links the article to its authors (the inverse property is *"are authors of"*);

- *Has/has not eligible users:* this property links the article to its target audience (the inverse property is *"are eligible users of"*);

- *Has offer:* this property links the article and the Destination to its offer, if present (the inverse property is *"is offer of"*);

- *Has paragraph:* this property links the article to its paragraph (the inverse property is *"is paragraph of"*);

- *Has source:* this property links the article to its source (the inverse property is *"is source of"*);

- *Has sponsors:* this property links the article to its sponsor (the reverse property is *"is sponsors of");*

- *Has Hyperlinks:* this property links the paragraph to its hyperlink (the inverse property is *"is hyperlinks of"*);

- *Has video audio image:* this property links the article and the paragraph to video, audio and images (the inverse property is *"are video audio image of"*);

- *Includes point of interest (destination):* links the article and the paragraph to their point of interest (the inverse property is *"is point of interest of"*).

Specifically, for the "*Article*" class, the following data properties have been used (shown in Figure 6 within the grey rectangle next to *Article*) which correspond to specific characteristics of the article:

- *Article Title;*

- *Article Over Title;*

- *Article subtitle;*

- *Creation date* of the article*;*

- *Description:* short description of the article or abstract;

- *Duration:* estimated time for reading the article;

- *Keywords* of the article;

- *Articolo Tematico eventi:* boolean;

- *Article language*.

In addition to the data properties listed that refer to the Content of Interest (article), the following data properties were used:

- *Paragraph title;*

- *Paragraph subtitle;*

- *Paragraph order:* indicates the position of the paragraph within the article;

- *Paragraph Text:* textual content of the paragraph;

- *Url:* sequence of characters that identifies a source;

- *Description:* short description;

- *Name* of the class;

- *Image Credit.*

## 6.3 The "Destination" dimension

The "*Destination*" dimension corresponds to the attraction on the territory that can be correlated to a point of interest (x, y coordinates) or to a geographical area ("geometry") that remains in the medium-long term (e.g., The Colosseum, the Fountain of Trevi, the city of Rome, etc.)

Furthermore, this class represents a particular point that someone finds useful or of interest. It can be a monument, an accommodation facility, a shopping centre, a ski area, etc. This class can be considered as a place (in fact the class is defined as a sub-class of "Entity-Entity" of the L0 ontology which in turn can be an object or a place). This type of modelling considers both single destinations and multiple destinations (e.g., 'the Cinque Terre').

The image below (*Figure 7*) shows the high-level scheme relating to the Destination.
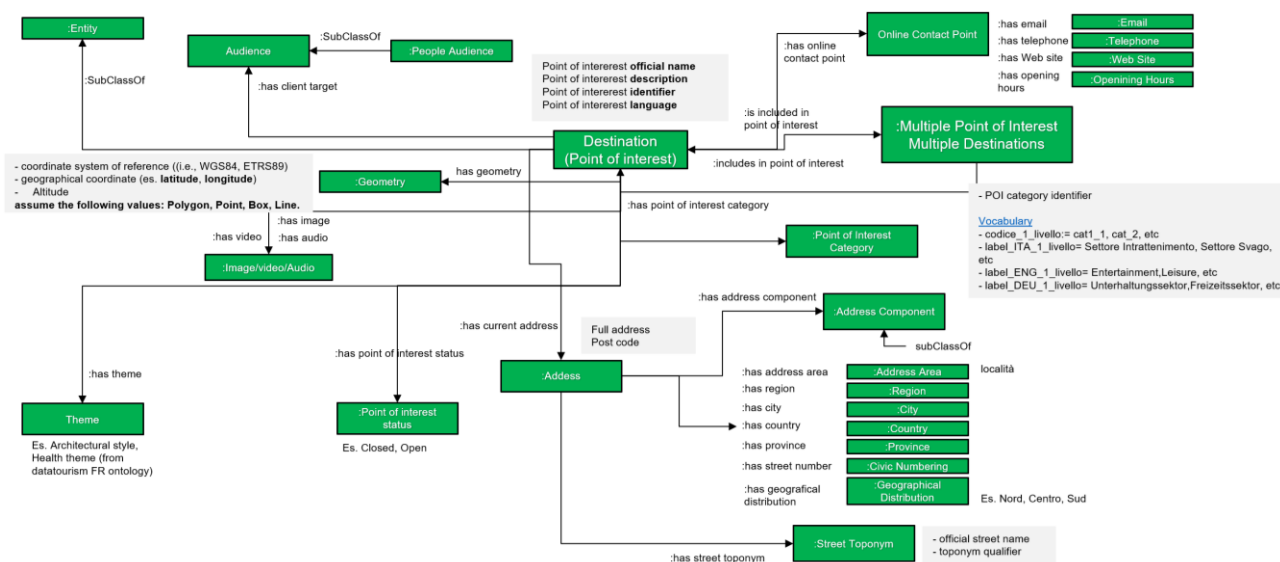


*Figure 7– High-level scheme of "Destination" dimension*

For this dimension, Ontopia's POI[8] ontology has been used. Only the main classes and properties are listed below.

*Classes in the modelling phase:*

- *Multiple Destinations (Multiple Point of Interest):* this class represents a collection of points of interest (e.g., 'Cinque Terre');

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[8] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POI

- *Destination (Point of Interest):* represents de facto a useful superstructure for modelling destinations and points of interest;
- *Geometry:* represents the geometry associated with a spatial entity (i.e., geographic coordinates, latitude, longitude and altitude);
- *Geometry type:* represents the type of geometry. Currently, the class assumes these values: polygon, line, point, square;
- *Point of Interest Category:* this class represents the category by which to classify the point of interest. It takes on the values of a controlled vocabulary;
- *Point of Interest Status:* this class represents the state of the point of interest. Its values can be, for example, "open", "closed", "under renovation", etc.

The following Object Properties were used in the modelling phase:

- *has geometry:* anything from the domain to a geometry, connects the geometry to its type (polygon, point, line);
- *has point of interest category:* this property links the point of interest to its general category (inverse property: *"is point of interest category for"*);
- *has point of interest status:* this property links the point of interest to its status (inverse property: *"is point of interest status for"*);
- *includes point of interest:* this property links a multiple point of interest to all the points of interest contained therein (e.g., the multiple point of interest "*Cinque Terre*" includes point of interest *"Monterosso al Mare"; "Vernazza"; "Corniglia"; "Manarola"; "Riomaggiore"*);
- *is included in point of interest:* inverse property of *"includes point of interesse"* (e.g., *"Corniglia"* is included in point of interest *"Cinque Terre"*);
- *has current address:* property that links a point of interest to its address (the inverse property is *"is current address of"*).

The following Data Properties were used in the modelling phase, including:

- *point of interest official name;*
- *name of point of interest category:* represents the label (name) of the category of the point of interest. Refers to the following controlled vocabulary which contains the following fields:
    - *codice_1_livello: = cat1_1, cat_2, etc.,*
    - *label_ITA_1_livello: = Settore Intrattenimento, Settore Svago, etc.,*

o *label_ENG_1_livello: = Entertainment, Leisure, etc.,*

o *label_DEU_1_livello: = Unterhaltungssektor, Freizeitssektor, etc.*

- *point of interest description:* represents a generic description of the point of interest;

- *status:* represents the label (string) of the status of the point of interest;

- *point of interest language.*

### 6.4 The "Offer" dimension

The "Offer" dimension indicates a tourist object that can be consumed / booked / visited for a price (e.g.: a hotel room, an entrance to the museum).

In the image below (*Figure 8*), the high-level scheme relating to the Offer is shown, which will be explored with the inclusion of the specific offer areas in the TDH. At the centre of the diagram, we find "Offer", which is the class that expresses the concept of Offer. This class can be addressed by two specific related classes:

- *Offer Audience:* Target audience of the offer (e.g., offer relating to certain nationalities); from the moment the audiences are not specified, the offer is applicable to any audiences, otherwise the audiences become binding for the offer*;*

- *Offer Locale:* tuple of attributes (language, currency, country, translation) in which to decline and activate the offer*.*
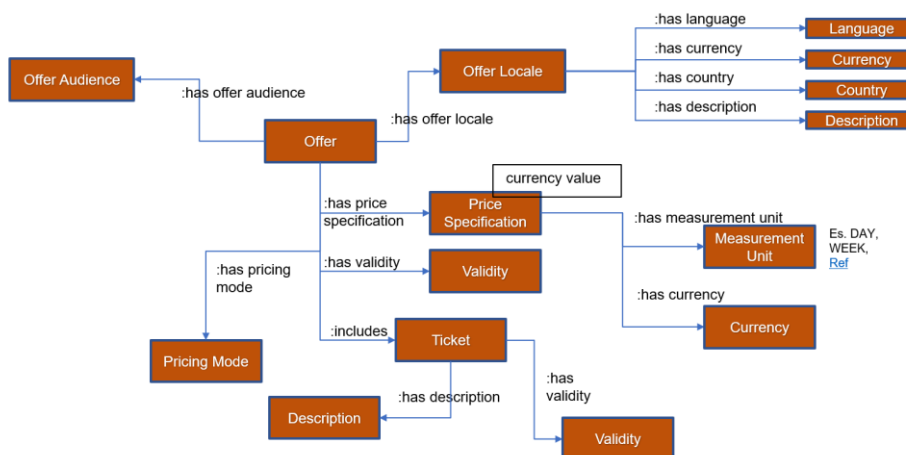


*Figure 8 – High-level scheme of "Offer" dimension*

For this dimension, Ontopia's POT[9] ontology has been partly used. Only the main classes and properties are listed below.

The following classes were used:

- *Language* in which the offer is declined;

- *Currency* in which the offer is expressed;

- *Country* where the offer is valid;

- *Description:* this class indicates a short description of the offer;

- *Price Specification:* this class represents information about the offer price. This has within it, in turn, two other classes:

  - *Measurement Unit (class that is used to represent a unit of measurement, such as day / week ...);*

  - *Currency (class that is used to represent the currency of the offer);*

- *Validity:* this class indicates information regarding the temporal validity of the offer;

- *Ticket:* this sub-class is used to indicate the ticket or any type of receipt relating to the offer. Two other classes are connected to it: *Description* and *Validity.*

- *Price mode:* this class represents the type of *hotellerie* price, usually it is the price per room or per person.

The following object properties were used:

- *has offer audience:* this property links the Offer to the Audience to which it is addressed;

- *has offer locale:* this property links the Offer to the Local Offer class;

- *has language:* this property links the Local Offer to the language in which it is declined;

- *has country*: this property links the Local Offer to the target country;

- *has description:* this property links anything of the domain (Offer, Offer Locale, Ticket etc ...) to its description;

- *has price specification:* this property links the offer to its price specification ("*is price specification of*" is the inverse property);

- *has validity:* this property links the offer and the ticket to their validity *("is validity of"* is the inverse property);

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[9] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POT

- *has measurement unit:* this property binds the specification of the price *(Price Specification)* to the *Measurement Unit* class *("is measurement of"* is the inverse property);

- *has currency:* this property links *Offer/Price Specification* to *Currency ("is currency of"* is the inverse property).

- *Includes:* property that links the *Offer* to *Ticket*.

# CHAPTER 7 – APPLICATION CASE: HOTEL TOURISM

## *7.1 Introduction*

The application case relating to the hotel industry – hotel accommodation facilities is described hereunder.

The ACCO[10] ontology was taken as a reference, which is the ontology of the Italian application profile on accommodation facilities. In this case, our interest is Accommodation Facility: this class, being a point of interest, is therefore considered as a sub-class of Destination / PointOfInterest defined within the POI ontology (ontology of the Italian application profile concerning points of interest). For this reason, it inherits all properties and classes of the point of interest.
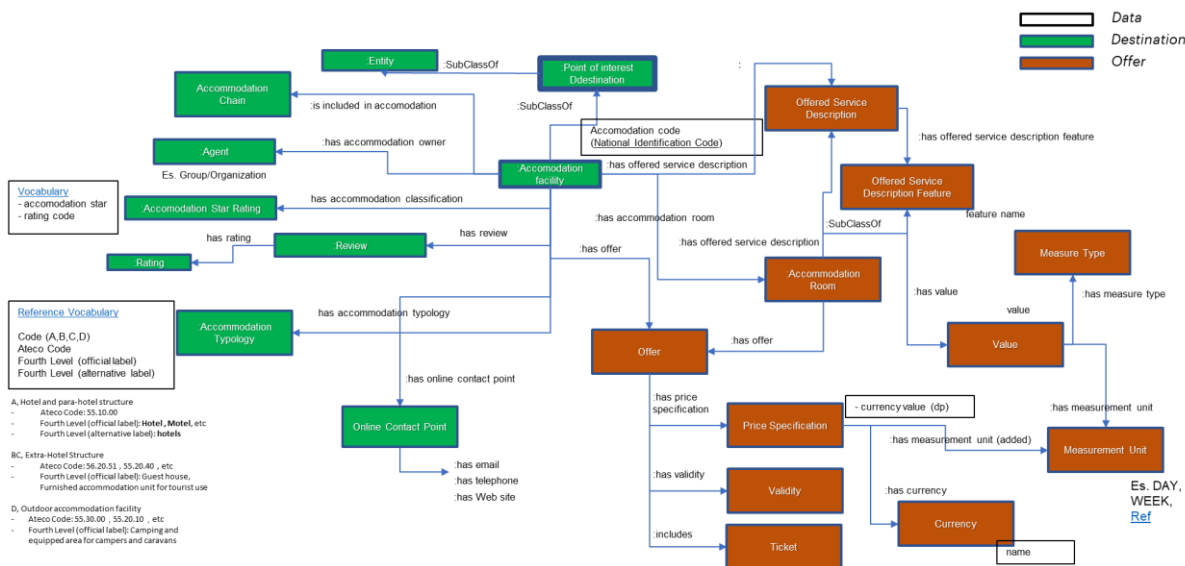


*Figure 9 – High-level scheme of ontology related to "Hotel industry" application case*

Multiple classes were used in the modeling phase, including:

- *Accommodation Facility*.

- *Accommodation Chain:* to connect an accommodation facility to a chain of accommodation facilities, which in turn is an accommodation facility;

- *Accommodation Star Rating:* this class represents the star classification of accommodation facilities. The values of this class must be defined as indicated in the following controlled

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[10] Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/ACCO

vocabulary https://ontopia-lodview.agid.gov.it/controlled-vocabulary/classifications-for-accommodation-facilities/accommodation-star-rating;

- *Review:* this class represents the reviews relating to the accommodation. The Rating class is also linked to this class, which represents an evaluation of users;

- *Accommodation Typology:* this class represents the type of accommodation facility. The elements of this class must be defined on the basis of the controlled vocabulary available here: https://w3id.org/italia/controlled-vocabulary/classifications-for-accommodation-facilities/accommodation-typology. This controlled vocabulary defines the types of accommodation facilities as identified in Legislative Decree No. 79 of 23 May 2011;

- *Online Contact Point*: this class represents an online contact point (e.g.: social network accounts, e-mails, websites, etc.)

- *Agent*: this class represents the owner of the accommodation facility, which can be, for example, a group or an organization.

Classes related to the offer:

- *Offer:* this class represents the concept used for the offer. It includes Ticket, Validity Price Specification and Pricing Mode;

- *Offered service description:* this class represents a description of the service offered;

- *Offered service description feature:* this class represents a specific characteristic of the description of the services offered by the accommodation facility and / or by the single room. An example of a feature could be the bathroom, the bed, the space occupied by a bedroom, etc.;

- *Value:* represents the value of the specific feature offered;

- *Measure Type:* class that represents the type of measurement such as length, height, etc.;

- *Accommodation room:* represents an abstract class used to model a room / room of an accommodation facility.

### 7.2 Example application

In the Application case it is specifically shown a practical case of using the classes and properties of the ontology for modelling the Offer related, for example, to the Interest Content: "*The best 10*

*romantic hotels in Rome in 2021"*, An editorial article that refers to the Offer of 10 specific hotels in the "Rome" Destination.

Considering the "Content of Interest - Destination - Offer" scheme, the dimensions of the information triplet serving the tourist are as follows:

- *Content of Interest:* Hotel in Rome;

- *Offer:* Hotel rooms with their price and availability;

- *Destination:* 10 Roman hotels classified as romantic by tags.

**By way of example, using a simplified model compared to the one that will be published in the interoperability services via API**, the following image shows the enhancement of the attributes of a record aimed at representing a single Destination (Hotel 1) with the relative offer for room.

**HOTEL 1**

| Class | Properties | Description |
|---|---|---|
| Hotel | Name | Hotel centro |
| | Address | Piazza di Spagna 4, Roma |
| | Short Description | Nel cuore del centro di Roma, in una zona pedonale |
| | Long Description | Nel cuore del centro di Roma, in una zona pedonale a pochi metri dalla Fontana di Trevi |
| | Accommodation star | 4 stelle **superior** |
| | Status (Is in Activity) | Open |
| | Hotel Chain | NovHotel |
| | Credit Card accepted | VISA, Cash, BankTransferInAdvance, POS |
| | Telephone | 06111 |
| | email | hotelcentro@gmail.com |
| Hotel Features | | |
| | parking | True |
| | Sauna | True |
| | Wifi access | True |
| | Pet allowed | False |
| | No smoking | True |
| Tagging | Tagging Value | Romantico, Storico, Liberty, Design |

**HOTEL 1, ROOM 1**

| properties | Description |
|---|---|
| Room name | 302 |
| Number of spaces | 1 |
| Type of bed | Double bed |
| Occupacy (total) | max 4 people |
| Availability | 302 calendar dates |

**HOTEL 1, ROOM 2**

| | |
|---|---|
| Room name | 601 |
| Number of spaces | 2 |
| Type of bed | Double bed,Single bed |
| Occupacy (total) | max 5 people |
| Availability | 601 calendar dates |

**HOTEL 1, ROOM 1, OFFER ROOM 1**

| | Description |
|---|---|
| Price | 100 |
| Price Currency | Eur |
| Unit of measument | DAY |
| Pricing mode (*) | Unit based |
| Validity start date | 30/11/2021 |
| Validity end date | 06/12/2021 |
| Included breakfast | True |
| Cancel reservation anytime | True |

- Unit based = rooms in property.
- Occupancy based = number of people in the property.

**HOTEL 1, ROOM 2, OFFER ROOM 1**

| | |
|---|---|
| Price | 70 |
| Price Currency | Eur |
| Unit of measument | DAY |
| Pricing mode | Unit based |
| Validity start date | 30/11/2021 |
| Validity end date | 06/12/2021 |
| Included breakfast | True |
| Cancel reservation anytime | False |

*Figure 10 – Application Case explication*

The attributes of the hotel are shown in the 'Hotel 1' 'table, while the attributes of the' Room 1 'room of the' Hotel 1 'are shown in the' Hotel 1 - Room 1 'table. The 'Room 1' offer is shown in the 'Hotel 1 - Room 1 - Offer Room 1' table with the related attributes.

As for the offer, the example provides two rooms with the relative economic offer. For both, the following classes and properties are reported:

- *Price Specification;*

- *Unit of measurement:* used to represent the unit of measurement (day, week);

- *Pricing Mode:* indicates the price per room or per person;

- *Measurement Unit:* used to represent the unit of measurement such as day, week, etc.;

- *Offered Service Description Feature:* used to define the features offered by the hotel (e.g., parking, sauna, Wi-Fi) and the features of the individual rooms (e.g., "*Included Breakfast, Cancel Reservation Anytime*").

Object properties:

- *has currency:* links the price specification with the *currency* class;

- *has validity:* specifies the validity of an offer;

- *type of bed:* indicates the type of bed contained in the room (e.g., double bed);

- *occupancy:* indicates the maximum number of people contained in a single room (eg.2);

- *has price specification:* links an offer to a price specification;

- *has pricing mode:* links the offer with the type of rate per person or per room.

Data properties:

- *Tagging Value:* used to identify the tags associated with the accommodation;

- *Currency value:* the value of the offer;

- *Room name:* name of the room;

- *Number of spaces:* the number of spaces (e.g., two-spaces hotel room);

- *Type of bed:* the type of bed in the room (e.g., single, double ...);

- *Availability:* room availability by calendar (e.g., room 601 is available on 22, 23 and 24 December 2022);

- *Validity start date:* starting date of the validity of the offer;

- *Validity end date:* end date of the validity of the offer.

# SITOGRAPHY

**Official repository of ontologies and controlled vocabularies of the Public Administration**

Online reference: https://github.com/italia/daf-ontologie-vocabolari-controllati

**ACCO – POI (Point of Interest) Ontology**

Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POI

**ACCO – MU (Value and Measurement Unit) Ontology**

Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/MU

**ACCO – POT (Price, Offer and Tickets) Ontology**

Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/POT

**ACCO – ACCO (Accommodation) Ontology**

Online reference: https://ontopia-lode.agid.gov.it/lode/extract?url=https://w3id.org/italia/onto/ACCO

**ACCO – CPEV (Public Events) Ontology**

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**DataTourisme Ontology – France**

Online reference: https://framagit.org/datatourisme/ontology/

**Ontologies of accommodation facilities developed by the Computer Science department of the University of Innsbruck**

Online reference: http://ontologies.sti-innsbruck.at/acco/ns.html

**Good relations Language Reference**

Online reference: http://www.heppnetz.de/ontologies/goodrelations/v1.html

**DCAT-AP_IT**

Online reference: https://joinup.ec.europa.eu/collection/semantic-interoperability-community-semic/solution/dcat-application-profile-data-portals-europe/release/11