CHAPTER 6

The Iconology dataset

The creation of the dataset containing *icon* claims was conducted with a quantitative question-driven approach grounded on the main inquiries of the art history field. The dataset creation was structured in phases, namely: 1) study of the domain and definition of RQ, 2) ontological modeling, 3) database design, 4) database population, 5) cleansing, 6) conversion into RDF, 7) alignment, and 8) evaluation.

The study of the domain and the ontological modeling were already treated in Chapter 5, whereas the evaluation will be addressed in Chapter 8. In this chapter, we describe the remaining phases. Furthermore, we present the modeling of the remaining items included in the metadata, such as artworks metadata, people, and books.

6.1 Sample selection and description

Panofsky's scholarly literature was gathered from the published bibliography by Previtali (2009) and by the Dictionary of Art Historians,[1] for a total of 79 articles and books. The criteria for selecting the books that could be described were 1) the availability of an English translation, 2) the presence of artwork depiction, and 3) the focus on Middle Ages or Renaissance/Late Renaissance art. Out of them, 20 were excluded for the lack of a translation, for a lack of depictions (6) or theoretical theme (12), and out of topic (2), obtaining 59 references. For answering the current study research questions, we focused on a selection of the most important books for iconological studies.[2]

6.2 Database creation

The database for data population consists of a Google Spreadsheet divided into 1) tables for actual data entry, and 2) tables for controlled vocabulary to be used in the descriptive tables, progressively extended as soon as the database was populated with information.

1 https://arthistorians.info/

2 As the project had to be conducted by a single person in a 3 years long period, the source data were sized down to a manageable volume.

Published in: Sofia Baroncini, Diving into artworks interpretations through the lenses of semantic data. An Application on Panofsky's Iconological Studies, Heidelberg: arthistoricum.net 2026, https://doi.org/10.11588/arthistoricum.1462

6.2.1 Database modeling

The database modeling was developed on the basis of the characteristics of the 11 case studies in Baroncini et al. (2021) and of the ontology discussed in Chapter 5. Consequently, we can define the basic requirements as follows:

- The database should include the subdivision into the ICON recognition types, according to the levels;
- The type of subject for each level should be specified;
- It should be possible to register relations between subjects at different levels (e.g., second level subjects composed by a group of level 1 subjects);
- It should be possible to cite other recognitions;
- Recognitions shall be grouped into interpretations, and further details about the interpretation can be recorded;
- It should be possible to include divergent recognitions.

Following these requirements, a first draft of the tables was created and tested with the described test cases. Therefore, a table for each interpretation type was created, plus one for artworks metadata description, one for people description (artists, interpreters), and multiple tables for the controlled lists of artwork type, style, subject entry, and cited texts. As a result, we obtained a scheme of tables expressing a theoretical framework of the features of *icon* interpretations that is relevant to describe, according to Panofsky's theory. The dataset population led to further improvements. A column and a controlled list of terms for relations between artworks were added, plus tables for descriptions of books and the text they express. Each time a new feature was added to the tables, the descriptive ontological framework was enriched to express it by reusing existing ontologies. In other words, each choice for the modeling of the database implied the definition of its formal conversion to RDF. For example, we provide two tables for the description of books, as we consider them composed of 1) a physical part and 2) the text they carry, in compliance with the CIDOC-CRM modeling to which such information is converted in a second moment.

6.2.2 Tabular framework

Tables included in the tabluar framework have different roles. Whereas part of them are tables in which the actual content is collected, other tables consist of lists of controlled terms to uniquely identify objects included in the previous tables. Main tables include the description of artwork metadata, books and the text they carry, the recognitions of objects at each level of interpretation, and of symbols. The second type of table is needed mainly to uniquely identify the objects, create controlled lists for field completion in other tables, and indicate alignments with external sources

if retrieved. We include tables with controlled lists for places, people, style, period, type of cultural object, and type of relationship between cultural objects. Furthermore, another table provides the controlled terms for the subjects described at each level and their possible alignment.

In this section, we briefly introduce the entities described in the main tables. Some general rules apply to the tables. Each term is identified either by its name, a number, or an alphanumeric string, according to the cases. If multiple terms for the same field exist, they are separated by the symbol "@", which will be used as a separator during the RDF conversion to create seaprate entities for each term.

6.2.2.1 Table for Cultural Objects

In this table, the metadata description of the cultural object is provided. It includes details about the author, the uncertainty of the author attribution, the title, years or century of creation, material, type (e.g., relief, painting), the place and city of conservation, and the URI identifying the book in which it is described. Furthermore, if the artwork has a relation with another one (e.g., is part of, a copy or a drawing of another cultural object) or parts of the same object (e.g., a scene of a fresco), it is possible to insert such related object by indicating its ID and further specifying the desired relation. Other columns are dedicated to the possible URL of the image if it is retrieved, its source, image rights, and the presence of an existing URI for the cultural object described (e.g., a Wikidata ID). Furthermore, other columns indicate style, period, and material, in which only terms from the respective controlled lists specified in different tables are allowed. All these characteristics are summarized in Table 6.1.

6.2.2.2 Tables for Book description

The book description is divided into two tables: the table 'Book' for describing the material aspects (signature, editor or printer, date and place of production), and the table 'Book Content' for the description of the text carried by the material book, of which we only describe the author and title of the text. Whereas the Cultural Object table refers to the ID of the book's material aspect (e.g., when illumination is part of a manuscript), the Book content identifier is recalled in recognition tables when the text is cited as evidence of recognition.

6.2.2.3 Recognitions and interpretations

The content of the scholar's interpretation is described in five tables. Three of them describe the subjects recognized at each level, namely the first, the second, and the third. One table is dedicated to the description of the Visual Pattern citations, in which a relation between first-level objects belonging to two artworks is established. Another is dedicated to the thorough description of symbols.

Table 6.1: Fields described in the table for cultural objects description

Feature	Description
ID	A number from 1000 to 9999 that identifies both the physical object and the respective artwork. Test cases, external artworks, and types have letters added, respectively, 'test' (eg. 1001test), 'ext' (e.g., 1001ext), and 'test' (e.g., 1001test)
Author	The name of the author(s) responsible for the creation of the artwork, that should be added to the list of controlled values in the table 'People'. The names should be written in the format <name> <surname>. If multiple authors occur, the symbol "@" is used as a separator, to model the authors as separate entities in the final graph
Certainty	Indication of the author's certainty. If the author's attribution is not certain, insert a '?'.
Title	The title of the artwork
Title for checking duplicates	A string containing, if present, the author, title, date, city, and location (e.g., 'The firmament, 1440, Florence, San Lorenzo'). It allows the detection of duplicate items during the database population phase, and it furnishes a label with a thorough description of the artwork.
Date	The date of the artwork creation. It can be expressed as an interval of years (e.g., 1450–1550), as a century (e.g., XII Century) or a portion of it (e.g., late, early, first quarter etc.)
Date certainty	Indication of the certainty of the date. If the attribution is not certain, insert a '?'.
Material	The material of the cultural object (e.g., marble). It must be included in the list of materials specified in the 'Type' table.
Book ISBN or DOI	The URL identifying the article or the book from which the interpretation about the cultural object is extracted. If it is discussed in multiple bibliographic records, all of them must be inserted here.
City of conservation	The city in which the cultural object is stored, which must be included in the controlled vocabulary of table 'Places'.
Place of Conservation	The location (e.g., church, museum, collection) in which the cultural object is stored, which must be included in the controlled vocabulary of table 'Places'.
Type of relation	If a relation with another cultural object occurs, this field specifies the type of such a relation (e.g., 'part of', 'study for', 'companion piece of'). The values should be inserted in the table 'TypeOfRelation'.
Related artwork	If the related object is an artwork, this field is filled with the descriptive label. The artwork must be described in the current table.
Related Book	If the related object is a book (e.g., a manuscript), this field is filled with the respective descriptive label. The book must be described in the 'Books' table.
IDext	If a related object is described, this field contains its ID.
Specific location	field for possible further indications about the portion occupied by the cultural object on the related object. For example, a relief on the East portal of a church will have a specific location 'East portal'.
Object Type	The type of the related object (e.g., 'building)
Style	The cultural object style. It must be included among the styles listed in table 'Style'.
Period	The cultural object period (e.g., 'Renaissance'). It must be included among the periods listed in table 'Style'.
Source Link	A possible URL at which the object is described
ImageLink	A possible URL of the object image
ImageLicense	the image license
Image Rights	If indicated, the image rights holder
URI	The URI identifying in an unique way the object in another knowledge graph (e.g., Wikidata)

In the case multiple interpretations of the same artwork occur (e.g. when various references describe an artwork or when the art historian cites interpretations by other scholars), such interpretations are described in the table 'Interpretations.' There, interpretations concerning the same artwork are progressively numbered. Such a number is also reported in each recognition, composing the interpretation in the remaining tables in the dedicated field. During conversion to RDF, the unique identifier of each recognition will include such a number. Besides the Artwork ID (e.g., 1001ART), further features can be described in the Interpretation table, namely: the date in which the interpretation was made, the author, and the source.

As introduced in Chapter 5, an interpretation is made up of single recognitions. In the remaining tables, every row identifies a single recognition. All the recognitions can be further specified by adding 1) the citation of evidence on which the recognition is based (e.g., recognition of the personification of abundance based on Ripa's *Iconologia*) and its specific part, if any (e.g., the exact verse of a poem), 2) the bibliographic reference from which the interpretation was extracted, 3) the person responsible for the recognition, and 4) the indication of another recognition that the current recognition supports (e.g., the recognition of a visual citation from a classic relief in a Middle Ages artwork supports the phenomenon of 'reuse of classical motifs deprived of their content'). In the following sections, we report the remaining descriptions of the recognitions at each level.

6.2.2.4 Table for First Level description

In the first-level description table, the pre-iconographical recognitions are described. According to Panofsky's theory, such subjects are Natural Elements, Actions, and Expressional Qualities, which may be gathered in compositions, i.e., groups of related subjects that may be further interpreted at the second level of interpretation. Therefore, such elements are the subjects described in this table (see Table 6.2). Compositions may be further described by a Compositional Structure, i.e., the visual arrangement that they present, such as a mathematical perspective or a pyramidal composition among three characters.

In the ICON ontology modeling, we further introduced the concept of qualities that the artwork may have, namely further description of the particular appearance of the subject as depicted in the specific artwork under examination (e.g., colors, cardinality, pose). During the description of artworks, it was necessary to introduce another field for describing the text included in the representational surface, such as the written names of the depicted characters (Linguistic Object). Furthermore, we introduced the field 'Style', to be used when a style is attributed to a single object depicted rather than to the whole cultural object (e.g., Roman columns depicted in a Renaissance painting).

A progressive counting in each artwork uniquely identifies the Artistic Motifs and Compositions described, respectively the subjects as manifested in the specific artwork and their eventual gathering. The relation between each composition and its members is established through the field 'Composed by Artistic Motif', in which the counting of the respective Artistic Motifs is reported.

Table 6.2: Fields described in the table for pre-iconographical recognitions

Feature	Description
Artwork	The artwork ID (e.g., ART1001)
Artwork Interpretation	If multiple interpretations are present, this field indicates the progressive number of the interpretation, further described in table 'interpretations'
Artistic Motif Count	This field contains a progressive number which uniquely identifies every subject recognized, either Artistic Motifs or Groups of them (i.e., Compositions)
Natural Element	The objects, human beings, and natural items that can be experienced which are depicted in the artwork
Expressional Quality	An Expression Quality corresponds to the 'expressional subject matter' described by Panofsky (1972). It individuates, by way of example, emotions, an atmosphere, and the character of a person.
Quality	Specification of the subject recognized, i.e., Natural Element, Action, or Expressional quality. Such specifications may be, for example, color, pose, and age.
Action	An event as recognized at level 1 of interpretation, e.g., a man who lifts one hand or a man riding a horse. Usually, actions are included in Compositions which include the other subjects performing the action.
Linguistic Object	The writings included in the artwork surface
Style	The style of a subject recognized (e.g., 'Roman' sculpture). It must be included among the styles listed in table 'Style'.
Composition	Compositions are groups of Artistic Motifs. In this field, a progressive number uniquely identifying the compositions in each artwork is specified.
Composed By Artistic Motif	In this field, the artistic motifs which are part of the composition are indicated through their number, assigned in field 'Artistic Motif Count'.
Compositional Structure	Description of the eventual shape (e.g., pyramidal), or an ordering principle (e.g., perspective) that characterizes the positions of the objects included in the composition.

6.2.2.5 Table for Visual Citations description

In this table, relations between first-level subjects or compositions between two artworks involved in a Visual Citation are established. It is done by indicating, for each recognition, the copying and copied artwork ID, and the count of the respective copying and copied Artistic Motif or Composition. The counting corresponds to the one expressed in the table for the first-level description previously desribed.

6.2.2.6 Table for Second Level description

Similarly to the First-Level Subjects table, the second-level one describes the level 2 subjects recognized and their possible specifications. Table 6.3 summarises the fields included. According to the ICON modeling, such subjects are Characters, Places, Events, Named Objects, Personifications, and Symbols, which can be grouped into Stories, Allegories, or Invenzioni. During the database population, it was necessary to introduce another column for the artworks depicted in the artwork under examination, to be selected from a controlled vocabulary with all the Cultural Object IDs from the respective table. Each row (i.e., each recognition) recognizes either one of the single subjects or a collective one (i.e., Allegories, Stories, and Invenzioni). If a single subject is recognized as part of a collective subject in the painting, this is stated by indicating such collective subject in the respective field. The recognition of the collective subject is also stated by describing it in a new line to allow for the description of the provenance assertion (e.g., the person responsible and evidence, if any). The eventual correspondence with level 1 recognitions is provided by indicating in the fields Artistic Motif and Composition the progressive number identifying them, assigned in the table for first-level descriptions. Furthermore, if one or more of them had a relevant role in the iconography identification, they are indicated in the field 'Recognizing Attribute'. During the data population, we introduced the fields of 'Role' and 'Source Actor', to better describe the situations in which a second-level subject was depicted in a specific role and when a Character had the facial traits of an existing person.

6.2.2.7 Table for Symbols description

Symbols recognized in the Second-Level Subjects table are further described in this table according to the Simulation ontology. Each symbol, called *Simulation* in the ontology terminology, is split into 1) the symbol depicted in the artwork, called *Simulacrum*, and the symbolic meaning to which it refers, called *Reality Counterpart*. Further details may be provided, such as the type of Simulation which describes in a more thorough way what is the relationship between the symbol and its symbolical meaning (e.g., if it is an allusion to the meaning), or the Context in which such Simulation is used (e.g., Medieval or Renaissance). We enriched the description by providing a field for indicating the source in which the Simulation is found, such as classical poems in which an attribute of a deity is invested with symbolical meaning (e.g., the Venus's belt is a symbol of seduction in Homerus' Iliad).

6.2.2.8 Table for Third Level Description

Similarly to the previous levels, the iconological recognitions are described in the rows of this table, and a progressive number for each artwork identifies the recognized Intrinsic Meanings. The subjects related to it can be either concepts or Cultural Phenomena, according to the ICON ontology. The fields of Artistic Motif, Composition, and Image

Table 6.3: Fields described in the table for iconographical recognitions

Feature	Description
Artwork	The artwork ID (e.g., ART1001)
Artwork Interpretation	If multiple interpretations are present, this field indicates the progressive number of the interpretation, further described in table 'interpretations'
Count	This field contains a progressive number which uniquely identifies every subject recognized, either Images, when a single subject (namely Characters, Places, Events, Named Objects, Personifications, Symbols) is identified, or Invenzioni, when a collective subject (namely Allegories, Stories or Invenzioni) is identified. or Groups of them (i.e., Compositions). As each recognition identifies only one Image or Invenzione, the counting identifies also the recognition.
ArtisticMotif	In this field, the progressive number identifying an Artistic Motif, previously defined in the First Level description table, is indicated, if the recognized iconography refers to it. For example, if a book recognized in ART1001, identified in the first level as a Natural Element, with Artistic Motif count 2, is then recognized as the Named Object *Bible*, the artistic motif number 2 will be indicated in this field during the iconographical recognition.
Composition	Similarly to the field of artistic motifs, an iconographical recognition may refer to a Composition of Artistic Motifs rather than singular motifs. In this case, the counting identifying the Composition is reported in this field.
Recognizing Attribute	If one or more artistic motifs had a relevant role in the recognition of the iconography (e.g., the arch and arrows help the identification of Cupid), their identifying number is reported in this field.
Character	The second-level subjects recognized as Characters according to the ICON ontology, namely a real or imaginary being identifiable as a second-level subject
Role	the role in which the character is depicted in the specific artwork. For example, in ART1199 Saint Luke is depicted in the role of a painter.
Source Actor	This field is filled when the recognized character bears also a portrait of a real human being. The source actor must be inserted in the table 'People', from which a controlled list for the current field is created. For example, the character of the Young Mago recognized in ART1003test bears the portrait of a young Lorenzo de' Medici.
Place	This field concerns those subjects representing places with a precise identity, e.g., the city of Bologna.
Event	This field concerns those events with a precise identity, such as the battle of Cascina
Named Object	This field concerns those objects with a precise identity, such as the Bible or the Venus' belt.
External Objects	In this field, we include recognizable cultural objects, such as artworks depicted in the artwork under examination. For example, the drawings by the art historian Popp shows how certain Michelangelo's sculptures (registered as the External Object) were arranged in a unique project never realized.
Symbol	In this field subjects invested with a symbolical meaning are indicated. The description rule adopted consists of writing the symbol and the symbolical meaning separated by a high dash without spaces (e.g., 'soap bubbles-futility').
Personification	subjects in which a person is depicted to illustrate a concept (e.g., Personification of Charity).
Story	A combination of subjects representing narrative elements (e.g., the story of Hercules)
Allegory	A combination of subjects invested with symbolical meanings. Usually, at least a symbol or a personification should be involved (e.g., The abduction of Europa as an allegory of Christ saving the human soul).
Invenzione	A combination of subjects with presents the characteristics both of a Story and of an Allegory.

are used to indicate to which subject recognition the recognized intrinsic meaning refers if provided. For example, the recognition of the phenomenon 'Representation of classical content with contemporary formal motifs' in ART1142 refers specifically to Virgil, identified by Image 1.

6.2.3 Description rules and database population

Out of the selected books, we decided to include only the artworks having a picture in the book edition, to reduce the likelihood of erroneously selecting the artwork and to foster the retrieval of a digital image of the artwork itself. In certain cases, the cited artwork without an image was included because the art historian was providing a significant description of it, or the artwork was of crucial importance for proving his claim (e.g., the presence of a visual citation of the artwork in question). The chapter of the book (Panofsky, 1955) describing the activity of Suger, the abbot of Saint-Denis, was not included since no artworks were cited in it.

6.2.4 Database cleansing

For this study, the quality assessment was partially conducted on the tabular database. Processes for data cleansing and expression harmonization were adopted during and at the end of the manual insertion.

During the database population, values were progressively inserted in controlled lists, one for each type of entity (e.g., people, Natural Elements, etc.). This process was fundamental for remaining as relevant as possible to the language used by Panofsky without penalizing the use of a common vocabulary. Indeed, the use of drop-down menus of already inserted controlled lists enhanced the reuse of the already inserted terminology, if appropriate, during the data entry phase. Following this, a strategy for entity disambiguation was adopted. Since artworks could be described in multiple books, it was important to detect already described ones and use a unique identifier for those artworks appearing multiple times. To this end, a conditional coloring of the cells in the column for artwork description (including an indication of author, artwork title, date, and place of conservation) was adopted. The resulting cases were manually examined and eventually merged.

At the end of the insertion, a spelling check, a singular-plural forms harmonization, and resolution of uncertainty in inserted data (e.g., deciding if 'angel' is a second or first-level subject) and in expression variation (e.g., if saying 'laying pose' rather than 'reclined position') were performed. In particular, the spelling check was 1) manually conducted by reading the controlled lists in alphabetical order for a better comparison of word variations, and 2) passing it through an English spelling check tool. Through the same technique, the use of singular and plurals was detected, and data were normalized by using the singular form of the term, accompanied by the indication of 'multiple quantities' as a qualifier of the first-level object, as it is the level for describing the actual appearance of identified subjects. Through a Python script for finding similar

terms, ambiguity in data was checked. For example, it emerged that the term 'angel' was indiscriminately used both at the first and second levels of description. As it is a narrowly cultural-related entity, it was decided that it must be described at the second level only.

Before RDF data conversion, it was verified whether all the terms in the tables were included in the controlled vocabularies. If not, the single cases identified through the script were manually corrected in the source data.

6.2.4.1 Rules for normalization

To avoid mistakes in the data conversion process, rules for data entering were decided. This determined, for example, the way to write dates, uncertainty, and places. Furthermore, terms were translated into English, and old terms used by Panofsky were updated to the current use (e.g., we wrote the current preferred name 'Angelo Bronzino' instead of 'Agnolo Bronzino'), or corrected (e.g., the Pennysilvania museum reported by Panofsky is currently called Philadelphia Museum).

6.3 RDF data creation

6.3.1 Ontological modeling

In this section, we provide the modeling adopted for describing the various aspects of the objects included in the dataset. For the artwork content description according to the levels, we directly reused the ICON modeling described in Chapter 5. For the other aspects, we tried to reuse as much as possible the CIDOC-CRM standard (version 7.1). Other ontologies were used for more specific tasks, namely: CiTO[3] for describing citations, PRO[4] for describing people temporary roles, and the foundational ontology DOLCE[5] for first-level objects details.

6.3.2 Main objects modeling

Artwork. The artwork is represented both in its physical (`crm:E22_Human-Made_Object`) and visual (`icon:Artwork`) aspects, related by the property `crm:P65_shows_visual_item`. In the case in which the artwork is a building (e.g., a church), we use the class `crm:E24_Physical_Human-Made_Thing` instead of `crm:E22`. All the metadata about the artwork is related to the physical entity, according to CIDOC-CRM specifications, including the artwork's label and title. For the description of the content of the artwork according to the levels, we directly reused the ICON modeling described in Chapter 5, with little variation. Since the reference standard we adopted is CIDOC-CRM, we took some decisions to better integrate the ontological description in this context:

3 https://sparontologies.github.io/cito/current/cito.html
4 http://www.sparontologies.net/ontologies/pro
5 http://ontologydesignpatterns.org/wiki/Ontology:DOLCE+DnS_Ultralite

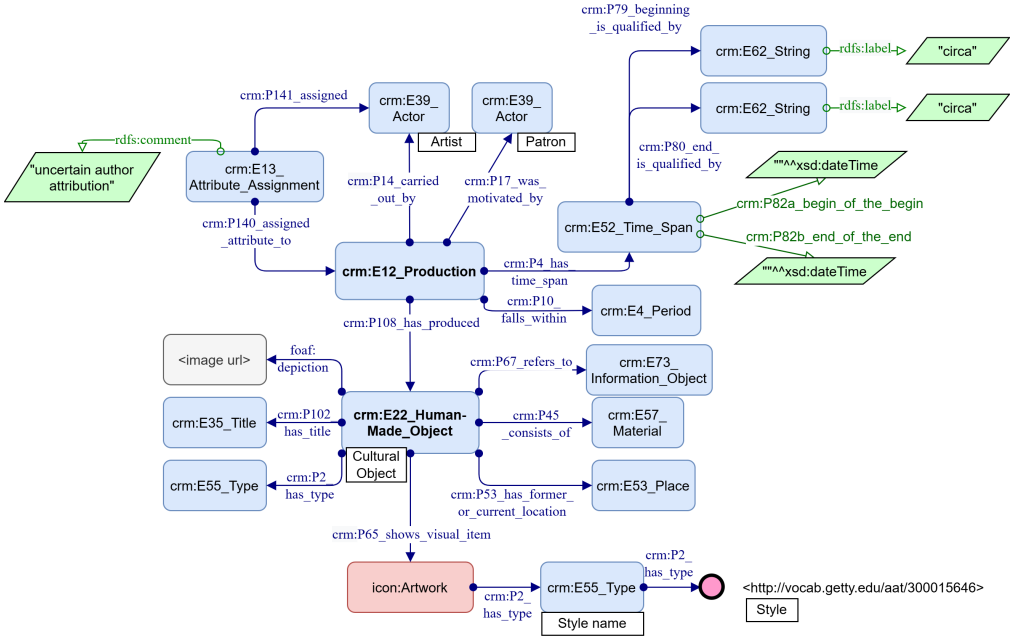

Figure 6.1: Modeling of artworks

- The person responsible for each recognition is a `crm:E21_Person`, linked to the recognition class through the property `crm:P14_carried_out_by`.
- Some recognized subjects were further specified with CIDOC entities. It is the case of the written text represented in the artwork (e.g., the names of the depicted characters), which are registered as level 1 subjects but with type `crm:E33_Linguistic_Object`, following the guidelines provided by the Linked.art project.[6] Similarly, the artwork depicted into another artwork was modeled as follows. An image is recognized at the second level of interpretation, and it is linked with the relation `crm:P138_represents` to the entity identifying the painting, possibly further described in the dataset. This modeling was adopted for three artworks, namely ART1373, ART1364, and ART1365, respectively representing OBJ1255ext and OBJ1256ext, OBJ1374, and OBJ1375.
- The recognized third-level concepts were expressed as `crm:E28_Conceptual_Object`, in order to maintain the general rule of using the standard, when possible.

The artworks metadata that we decided to describe are 1) its production act, with the further specifications of the author (`crm:P14_carried_out_by`), the possible patron (`crm:P17_was_motivated_by`), the dates of creation through a time-span (`crm:E52_Time_Span`), the period (e.g., Middle Ages) related through the property

6 https://linked.art/model/object/aboutness/

crm:P10_falls_within, 2) title (crm:P102_has_title), 3) material of which the object is composed, such as marble (crm:E57_Material, 4) its location, i.e., the museum or place in which it is preserved (crm:P53_has_former_or_current_location), and the type (e.g., relief, oil painting, etc), represented as a crm:E55_Type, related by the property crm:P2_has_type. Further features shown in Figure 6.1 will be described in the remaining paragraphs.

Person. The modeling of people regards the artists, patrons, portrayed characters, books authors, or editors, identified by the class crm:E21_Person. Sometimes, the artwork's author is not a single person, but a group, such as a school, and therefore represented as crm:E39_Group. In certain cases, to better document the final interpretation, it was relevant to register further details, such as the role held by the person or the membership in a group. Whereas the former was expressed through PRO ontology class pro:RoleInTime, further enriched with the required time indication, the latter was described through the property crm:P107_has_current_or_former_member, relating the group to the single person. The specified role is independent of the role that the person may have when depicted in an artwork (e.g., Vulcan depicted in the role of Teacher of the Mankind). We model it by reusing PRO classes and relations as from our data emerged the necessity to describe them as temporarily assumed roles (e.g., John VIII Palaiologos, Byzantine Emperor from 1425 to 1448), represented in the Benozzo's frescoes in the Medici Chapel, used as a test case for dataset creation and modeling.

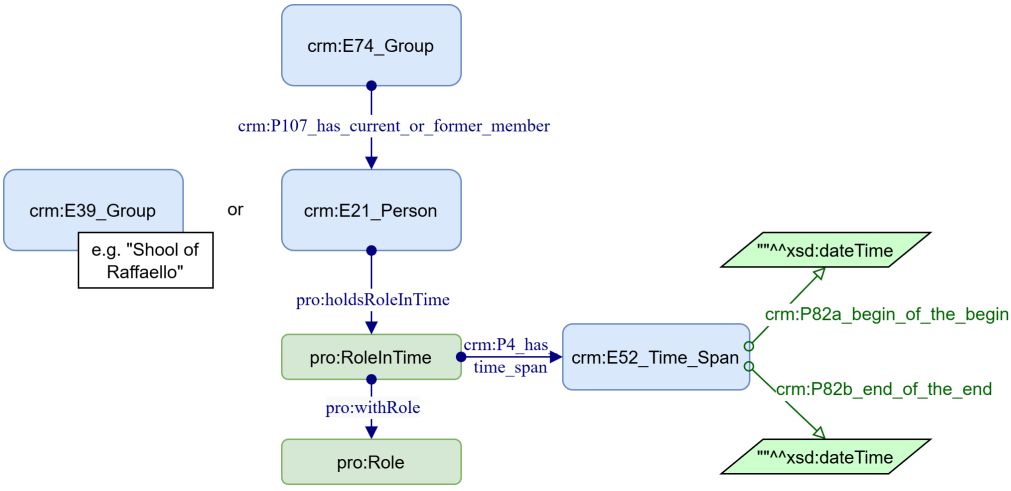

Figure 6.2: Modeling of people

Book. The relevance of books was progressively understood and therefore iteratively modeled during the database population process. Indeed, books have different roles in the described dataset. They can be the manuscript or book of drawings in which the artwork is depicted, or the book carrying the text cited as a piece of evidence during an interpretation. Since, in some cases, the interpretation was citing the text in which

the artwork under observation is placed, a modeling framework defining clearly the respective identity of the physical book and the text, along with their relations between each other, with the artwork, and with the interpretations was needed. For this purpose, we adopted the modeling provided by CIDOC-CRM (see Figure 6.3). The book in its physical meaning is represented by an instance of `crm:E22_Human-Made_Object`. Similarly to the artworks' metadata description, the physical book can be further specified with its production details, along with the date (or period) and place of creation, the person responsible (in this case, with the role of editor or printer), and an identifier (`crm:E42_Identifier`), through the relation `crm:P1_is_identified_by`, used, for example, to represent the manuscript's signature. The text written in the book is described as an instance of `crm:E73_Information_Object` and related through the property `crm:P128_carries`. The illumination in its physical meaning is identified as an instance of the class `crm:E25_Human-Made_Feature`, which can be part of a folio or page, identified as another instance of the same class. Both the instances are linked to the book through the relation `crm:P56i_is_found_on`.[7]

As shown in Figure 6.4, further details can be provided about the text carried by the book. If an author is given, he/she is specified as the author of the creation event (`crm:E65_Creation`) of the text. The title is specified through the relation `crm:P102_has_title`. If, during a recognition, a specific part of the text was cited as evidence, we created a new `crm:E73_Information_Object` entity to represent only the text portion. The whole text is linked to the latter by the relation `crm:P106_is_composed_of`.

Place. In the dataset, places are generally the locations in which the artworks are stored. Nevertheless, we distinguished between those places as physical locations (`crm:E53_Place`) and the museum or collection respectively as a legal body and as a physical entity (Fig. 6.5). This specification was made to indicate museums and collections as the places of the artworks without violating the range of the property `crm:P53_has_former_or_current_location`, which needs an entity of type `E53`. Furthermore, the localization into a wider region, e.g., a city or a country, was registered by the relation `crm:P89_falls_within`.

Style. Following the CIDOC-CRM and Linked.art indications, style is described as a type (`E55`) of the visual entity `icon:Artwork`, having as type the AAT term for *style* (see Figure 6.1). The modeling, already reused in the ICON ontology development, is also adopted in data creation. We adopted this pattern also for describing the style of single level 1 subjects depicted by the artwork (e.g., a classical column in a Renaissance setting).

7 Although we initially referred to the study by Bellotto (2020) for manuscript description through CIDOC-CRM, we do not directly reuse it as we encountered some inaccuracies in the use of properties. The author of the study describes the manuscript as a `crm:E71_Human-Made_Thing`. The property `crm:P165_incorporates` relates the physical manuscript (E71) to the text (E73), although the domain of this property, as specified in CIDOC-CRM documentation, is E73. A similar inaccuracy is found in the use of the relation `crm:P10_falls_within`, which must relate two temporal entities (E4), to describe the relation between the illumination and the book.

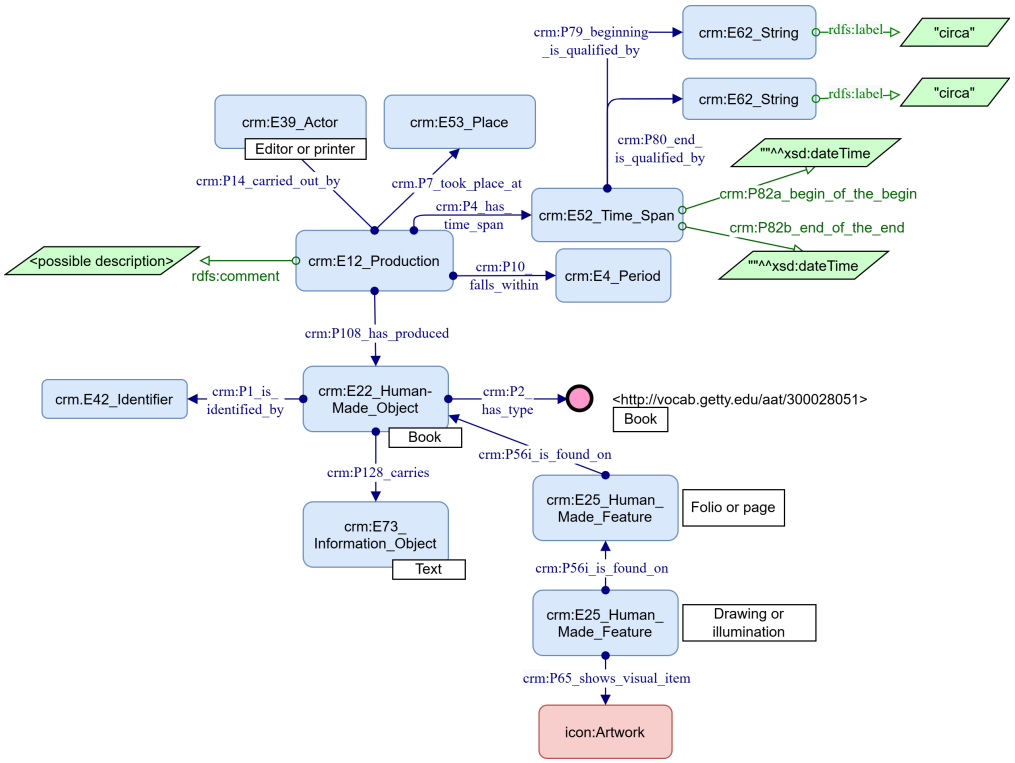

Figure 6.3: Modeling of books

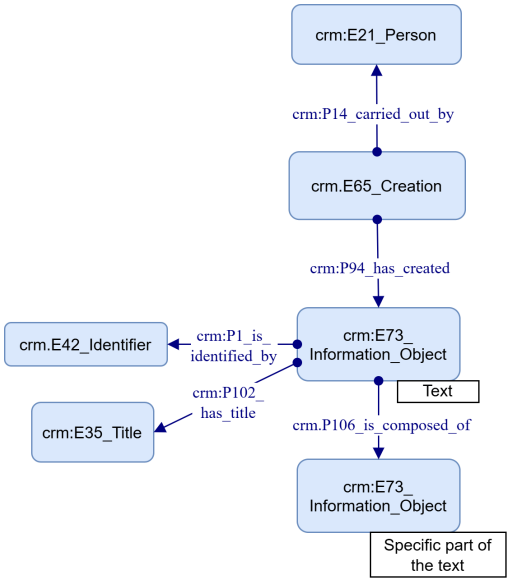

Figure 6.4: Modeling of books content

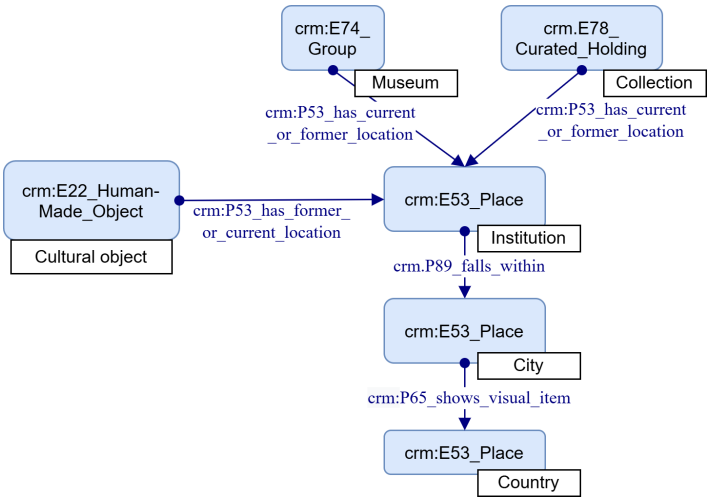

Figure 6.5: Modeling of places

6.3.3 Modeling challenges

The modeling phase, the table structure, and the conversion were iterative processes in which the gradual insertion of artworks led to improving the structure, although the core modeling could be set thanks to the test case studies. In the following, we describe some features that we included.

6.3.3.1 Artwork specifications

The major part of the types of artwork could be described according to the modeling cited above. Nevertheless, some specific types of artwork require specific modeling.

Feature, detail, or parthood. During the modeling, we had to decide how to consider the relation between a portion of an artwork and the whole. We identified different typologies:

1. The art historian examines only a portion of a whole artwork, presenting also a picture of the needed detail only. The portion is not a separate entity of the artwork (e.g., the detail of one painting)

2. The art historian examines only a portion of a whole artwork, but the artwork has a complex structure divided into multiple scenes. It is the case, for example, of many frescoes or pictorial cycles, such as Raffaello's frescoes in the Loggia of Psyche (Villa Farnesina, Rome), or Michelangelo's decoration of the vault in the Sistine Chapel.

3. The apparently unique artwork is composed of parts made by different artists in different periods. We provide as an example the case described by Panofsky (1955) of Vasari's frames surrounding already existing Medieval drawings (OBJ1427, OBJ1428, OBJ1429).

4. The artwork is part of another one having a different type. It is the case, for example, of a fresco (e.g., the cited above Raffaello's *Stories of Cupid and Psyche*) and the physical architecture (Loggia of Cupid and Psyche, Villa Farnesina, Rome). Although sharing the same surface, the two artworks are created in separate moments, eventually by different people. Another example belonging to this case is the creation of a miniature and the physical manuscript page on which it is represented.

5. The artwork identity can be recognized, it may be shown independently but it is conceptually or structurally part of a bigger one. The pales of a polyptych, the stone throne of a church, and the card of a deck, belong to this category.

After the identification of different typologies of relations between artworks, we modeled the illustrated cases as follows. In the first case, since the portion of the artwork exists only in relation to the art historian's interpretation, the artwork has a unique identity. To not diverge from Panofsky's reading, we maintained both an independent visual artwork and object when a single interpretation of it was provided, but when more parts of the same artwork were described on different occasions, the artworks ID were merged in a unique one, registering the different interpretations for the same artwork. It is the case, for example, of ART1123. Whereas in *Renaissance and Renaissance in Western Art* only Venus is described, in *Studies in Iconology* the focus is solely on Cupid.

In the second case, since the portion of the artwork can be identified, but is physically and conceptually part of a whole artwork, it is registered as a physical feature (`crm:E25`) related to the main artwork through the relation `crm:P56_bears_feature` (see Figure 6.6(a)). In this case, we have only one production instance associated with the whole artwork and separate instances of visual artworks.
We provide the same modeling for the third and fourth cases (Figure 6.7). As in case 2, the artistic objects are described as features. Nevertheless, since they exist due to different productions, a new instance of `crm:E12_Production` is associated with the feature. Also in this case, each physical instance (i.e., the Feature and the Human-made Object) has an instance of visual artwork associated.

The fifth case is expressed as two instances of Human-made Object (`crm:E22`), related by the property `crm:P46i_forms_part_of`, and one instance of Artwork is associated to each of them.

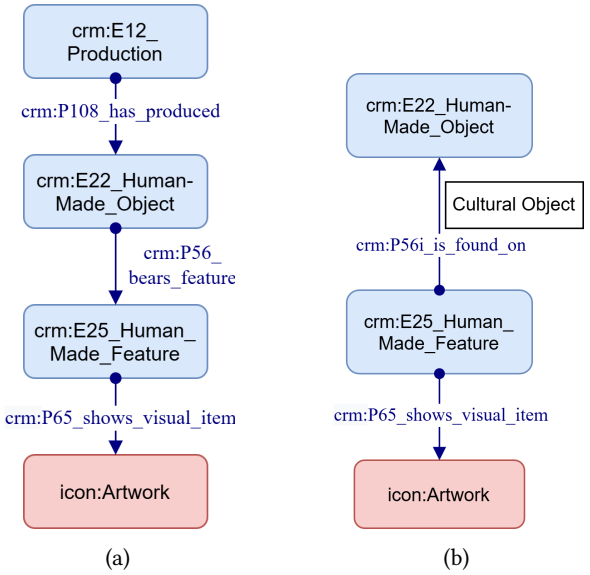

Figure 6.6: a) Detail of (feature-of relation), b) Modeling of specific location

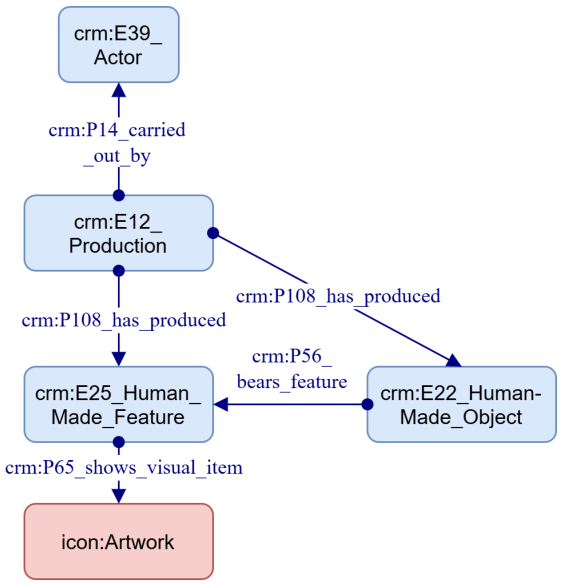

Figure 6.7: *Feature of* relation

Pendants. Artworks may be recognized to be narrowly related to other ones. According to the Getty Vocabulary definition, artworks which are 'designed, or purposefully chosen, to be displayed together'[8] are defined as *pendants*. We model a collective object representing the union of the companion pieces as an instance of `crm:E22`, as it is the recommended class for representing collective objects[9], and we then relate the two instances of physical artworks (E22) through the property `crm:P46_is_composed_of`. The aggregate object has type `aat:300179422`, identifying the typology. Four artworks of the dataset correspond to this case, identified as two couples of artworks (OBJ1522 and OBJ1468, OBJ1283 and OBJ1284). In both cases, the companion pieces are examined to better understand deeper meanings in the interpreted artwork.

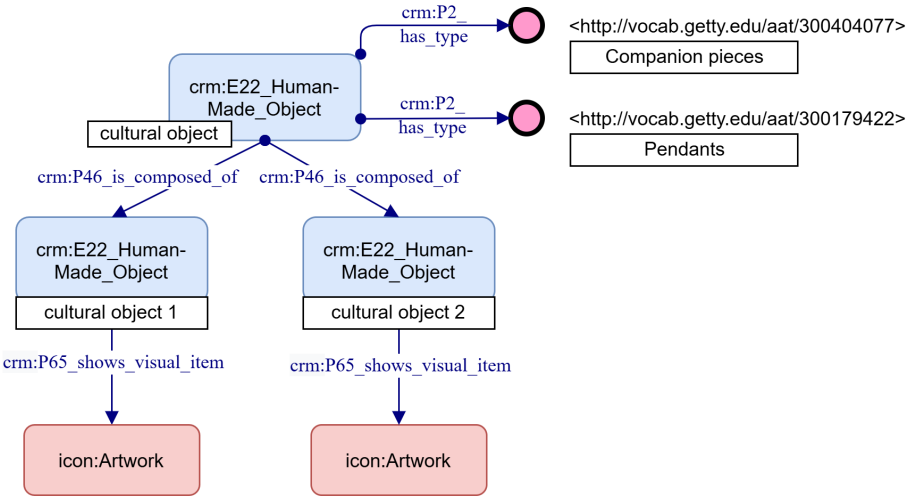

Figure 6.8: *Pendant of* relation

Specific location. In the metadata of the described artworks further information about their specific position on another cultural object was included. For example, it was indicated that the fresco under observation is placed on the dome of a building or in the east portal of a church. Another case is the indication of the exact page of the manuscript on which the illumination is placed. In these cases, we modeled the specific location as an entity of type `crm:E25_Feature`, which is further related to the instance of the final object (e.g., the building or the manuscript) through the relation `crm:P56i_is_found_on`, expressing that the final object bears the feature. We modeled the chain of relations through the property `crm:P56i_is_found_on`, which indicates that the artwork is found in the specific location. Another `crm:P56i` property

8 http://vocab.getty.edu/page/aat/300179422
9 https://www.cidoc-crm.org/Entity/e22-human-made-object/version-7.1.1

relates the cultural object to the specific location. This modeling is often used to express the relation between illuminations, illustrations, and reliefs, and the specific part of the whole object, respectively a manuscript or a book page, or a building part, and finally to the whole object itself.

6.3.3.2 Uncertainty

The modeling of uncertainty is a widely discussed topic in the Linked Data for Cultural Heritage community (Costa et al., 2010), as it is a concept often embedded in cultural heritage data. In this study, we decided to model the uncertainty encountered as comments expressing this fact in the registered data.

Uncertainty of author. The author attribution may be uncertain, information that is usually expressed as placing a question mark after the author's name in the artwork title. We modeled this uncertainty aspect by expressing the relation between the production event and the author as an Attribute Assignment (`crm:E13`) linking the two entities and adding to it a comment through the relation `rdfs:comment` specifying the uncertainty with the string 'uncertain author attribution'.

Date uncertainty. Multiple types of uncertainty relative to the date exist. One possible case is that the interpreter is unsure of the exact year of artwork creation, usually indicated by the formula 'c.' before the year. We expressed this case through the addition of a qualifier, i.e., the string 'circa', to the `E52_Time-Span entity`, as shown in Figure 6.1. To the author's best knowledge, there is no term to express uncertainty in the currently available controlled vocabularies. The uncertainty can be distinguished for the starting and ending date, by choosing the suitable relation among `crm:P79_beginning_is_qualified_by` and `crm:80_end_is_qualified_by`, respectively for uncertainty in the beginning and end date.

In other cases, date uncertainty is expressed with the terms 'ante' or 'before', to indicate that the artwork production necessarily happened before one specific date, and with 'post' or 'after', for indicating a production happened after a certain date. In those cases, only the available date, namely the start or the end of the assumed time period, is registered. Finally, it is common, in the absence of sources documenting the exact date of execution, that the creation date is indicated as a range between years or as portions of a century. We expressed the earliest and latest indicated dates as the extremes of such a time span.

Uncertainty in recognition. Sometimes the author expresses uncertainty over certain observed facts. This happened in a couple of cases, in which the art historian recognizes a first level object but she/he is uncertain about the precise identification of it. In describing Lotto's *Venus and Cupid* (ART1002test), Christiansen recognizes a wreath, made of laurel or myrtle (ART1002test). Furthermore, Panofsky, while describing

Tititan's *Sacred and Profane Love* (ART1329), recognizes two animals, hares or rabbits, in both cases symbols of animal love and fertility (Panofsky, 1972, p. 150). Since in both cases, the choice among alternatives was not the discriminant for further interpretations, we registered only one of the options, preferably the most probable.

6.3.3.3 Artwork content

In this section, we provide an overview of the challenges raised in the description of artwork content. They range from the description of style and visual arrangements to figures embedding the characteristics of multiple iconographies and the presence of meanings related to collective objects.

Style of objects represented. In some cases, the art historian observed a specific style not of the overall painting but of an object depicted in it (for example, the presence of classical columns in a Renaissance painting). The style modeling adopted in the ICON ontology (see Section 5.4) can be applied to every part of the visual surface of the artwork and, consequently, to each subject recognized as manifested in the artwork. In this way, it is possible to state that a subject has a specific style without asserting that all the artwork belongs to the same style.

Meaningful visual arrangement of subjects. The perspective or visual composition in which subjects are arranged can lead to a deeper understanding of their meaning. It happens, for example, in the description of two representations of the planets and their children (Bodl. ms. or. 133. (Arabic), XIV Century. *The seven planets and their children*, folio 25b, ART1031; *The children of Saturn*, 1420, Padua, Palazzo della Ragione, ART1032). While describing them, Panofsky says that the visual arrangement in a scheme bears a scientific attitude characteristic of the Arabians illustrations, afterwards abandoned in the Northern countries. In this case, we described the grid scheme as the `icon:CompositionalStructure` of the first level subjects and cited the Artistic Motifs involved in the visual arrangement as narrowly related to the phenomenon recognition, through the relation `icon:hasArtisticMotif`. Although it is challenging to model the cultural phenomenon recognition as directly based on the visual arrangement, we implicitly linked the fact by the relation with the recognized first-level objects.

Reference to iconographical types. A few times Panofsky himself was conducting real artworks interpretations according to the knowledge of an 'art type' (e.g., Zeus with certain attributes). This approach is a challenge to the adopted modeling, since the recognized subjects are always dependent on a specific artwork. The solution adopted consists in the creation of an artwork record to which the type is associated. The ID of the artwork includes the string 'type' to specify that it does not correspond to any specific work of art.

Characters depicted in the guise of other ones. In Western art, it is common to find subjects that express two characters. Mythological portraits, i.e., portraits of real people represented as mythological characters, are included in this typology. In other cases, they can be represented simply as characters part of the scene, as it happens in Benozzo Gozzoli's frescoes of the Medici chapel (`OBJ1003test`), where the three Magi and other participants bear the portraits of historical characters (e.g., Lorenzo de' Medici). Another case is when two iconographies are overlapped, e.g., between a character and an iconographical type. This can be seen in Lotto's Venus and Cupid (`OBJ1002test`), where Cupid is depicted with the attributes of the iconographical type of *puer mingens*. We modeled this special case with the ICON ontology by relating two Characters to the same Image, through the relation `icon:hasCharacter`.

Complex meanings deriving from a set of artworks. As iconology often explores the meaning of complex objects, it is often the case that the discovered meaning belongs to a set of artworks considered in their whole and taking into account their relations. It is the case, for example, of the interpretation of Correggio's decoration of the St. Paul chamber in Parma (OBJ1507)(Panofsky, 1961) or of the Medici Chapels in the San Lorenzo Basilica (OBJ1212ext) (Panofsky, 1972). The solution adopted consisted in providing a description of the overall object only at the deeper level, and specifying level 1 and 2 descriptions for separate artworks identifying the single part (e.g., the walls of the chamber).

6.3.3.4 The concept of evolution

The domain of iconology and iconography addresses the variation of iconography, symbols, and cultural phenomena over time. This analysis includes the variation of what is depicted and ideas and texts on which the artworks may be based. Therefore, in the considered data, we could observe the following nuances of the concept of evolution:

- The evolution of iconography and symbols. The art historian notes variations in how the iconography is depicted and its symbolic meaning in the considered artwork. Consequently, s/he interprets the pieces of visual evidence in which the variation occurs and analyzes it by assessing their spatial and temporal coordinates.
- The evolution of ideas. The artwork's specific realization is evidence of an external change in society, such as a new identity, taste, religious practice, or idea.
- The evolution of the text on which the depiction is based. In some cases, not only the actual notion expressed by the text or its interpretation changes. Especially when dealing with handwritten texts, words may vary and generate divergent visual interpretations of their content. An example is the illustrated rendering

of Petrus Berchorius *Metamorphosis Ovidiana*. Several illuminations of the manuscripts of the tradition of its text present variations motivated by errors in copying the text. In this way, for example, Venus emerging from the sea is represented in ART1121 (ms. fr. 373, folio 207, Bibliotheque Nationale de France, Paris) with a sea goose rather than a sea shell due to the error in the text of Berchorius, in which 'aucam marinam' is written in place of 'concam marinam' (Panofsky, 1969, p. 86).

- The evolution of the artwork itself. When an artwork is restored or damaged, the actual content depicted may vary. It is the case of Lorenzo Lotto's *Venus and Cupid* (ART1002test), in which the restoration unveiled some precious details adorning Venus (Christiansen, 1986).

These characteristics make modeling the concept of evolution embedded in various aspects mentioned previously challenging. Several studies have attempted to address the complexity of the topic at hand. One such study, conducted by Van den Heuvel and Zamborlini (2021), proposes a method for modeling time as *storylines*, defined as multidimensional networks that change over time. This concept is based on Kubler's theory of time (Kubler, 2008) and provides valuable insights. However, so far, no ontology has been released. Therefore, we plan to address this issue in future work, and we propose alternative solutions for the current project.

This thesis addresses the concept of evolution through the perspective of material artifacts (e.g., artworks, manuscripts). In other words, each artwork constitutes evidence of a different stage of evolution, whether of iconographies or cultural phenomena, in accordance with the definition provided by Panofsky of artworks as *documents of* a phenomenon (Panofsky, 1955). Accordingly, the time of the change is provided by the artwork's date. Furthermore, different aspects of the same cultural phenomenon are represented by a new cultural phenomenon. For example, the phenomenon *evolution of the iconography of Saturn* may be related to other specific aspects of it, such as *The accepted type of Saturn in late medieval art emphasizes his cruelty: Saturn devouring his child, Saturn castrate*. The relation is established by ascribing both phenomena to the same artwork in which the specific variation of the phenomenon occurs. In this way, a periodization of the phenomena can be provided on the basis of the dating of each piece of evidence. Nevertheless, this modeling choice has some limits. The overall argumentative discourse of the art historian, tracing a line of evolution, is currently not explicitly modeled in data. However, the evolution of iconography, symbols, and concepts can still be traced through a quantitative analysis that relates the subject to the dating of artworks.

6.3.4 Conversion into RDF

The conversion from the tabular format to an RDF graph was performed through a Python script realized for the purpose. The library used is RDFlib,[10] a library for parsing, creating and updating RDF graphs. Through the script, the information in each table column was accessed and converted according to the required modeling for each object described in Section 6.3.1. During this phase, the instances included in the modeling but not explicitly described were created (e.g., the instantiation of a `Production` entity for each Cultural Object). Accordingly, rules for creating URIs were established.

6.3.4.1 URI creation rules

To perform entity disambiguation, each identified instance must have a unique and specific URI. In the case of this dataset, we opt for using 'non-opaque' URI, namely, it should be possible for a human reader to easily understand the described content without recurring to the label. Although this facilitates the usability and comprehension of data from humans, it requires precise URI creation rules to be adopted during the conversion and to verify errors in URI assignment (e.g., the same URI is used for two different entities). This could happen, for example, if a string is used to describe two entities of a different type (e.g., 'Cupid' as a character and as a Story). For this reason, we set URI creation rules and a final RDF data verification through SPARQL queries.

We adopted different URI creation rules, namely 1) creation of non-opaque URIs composed by entity labels, 2) non-opaque URI with further specification of their type, and 3) identifiers composed by a progressive numeration and a string identifying their nature. In some cases, a composition of creation rules was adopted.

Non-opaque URIs. In the cases in which ambiguity was impossible to take place, and there was a need to make it easier to refer to the same entity without erroneously creating multiple URIs for the same entity, we created non-opaque URIs from the objects label. The URI was created starting from the instance label. Spaces and punctuation marks were replaced by a dash, letters were written in lowercase, and non-UTF-8 characters were converted to the respective ones (e.g., 'è' was converted to 'e'). This approach was adopted for the creation of URIs of most of the identified subjects.

Non opaque URIs with type specification. For disambiguation between entity types, in certain cases, we included the entity type in the URL, following the format `<d:+type+'/'+name_uri>`, where 'type' is a lowercase string identifying the type, and 'name_uri' is the non-opaque URI created with the rules described above. Table 6.4 provides an overview or entities following this rule along with real examples extracted from the dataset.

10 https://rdflib.readthedocs.io/en/stable/

In the case of conversion of places, further information about the city in which a building is placed is provided in the place name (see 'berlin' in the provided example in Table 6.4), to avoid that homonymous places are merged.

Table 6.4: Entities for which the type is indicated in the URI

Type of object	**String for type specification**	**Example**
Style	'style'	`d:style/classicizing`
Period	'period'	`d:period/florentine-renaissance`
Type of Relation	'relation'	`d:relation/project-for`
Cultural Object Type	'type'	`d:type/oil-on-wood`
Material	'material'	`d:material/stained-glass`
People	'person'	`d:people/ae-popp`
Quality	'quality'	`d:quality/standing-pose`
Linguistic Object (E33)	'linguistic-obj'	`d:linguistic-obj/preserpine`
Story	'story'	`d:story/the-abduction-of-europa`
Allegory	'allegory'	`d:allegory/allegory-of-good-counsel`
Invenzione	'inv'	`d:inv/the-advent-of-the-celestial-venus`
Personification	'pers'	`d:pers/divine-justice`
Role	'role'	`d:role/teacher-of-mankind`
Place	'place'	`d:place/berlin-staatliche-museen`

Identifiers composed by a string and a number. The identification through progressive numbers is preferred for identifying those objects that are rarely repeated during the dataset population, such as books and cultural objects. Indeed, the search for duplicates was performed, and the respective IDs were merged after a manual verification of similar entities. Other entities for which an identifier was created in this way are: Artworks, Texts, Recognitions, Interpretations, Production and Creation Events, manifested objects (i.e., Artistic Motifs, Compositions, Images, Intrinsic Meanings), and Cultural Phenomena. In these cases, the identifier is composed of an incremental number associated with a string expressing the type of entity described (e.g., an artwork). In fact, associating an ID during the insertion phase helps in maintaining separate entities for the description of homonymous instances having the same type, as happened in the Cultural Object or Books field. Consequently, all the entities related to them (e.g., visual Artwork, Creation or Production events, manifested objects, Recognitions, and Interpretations) follow the same rule.

Besides the type, the ID such defined provides additional information about the resource. The initial part of it may indicate 1) the nature of the described object, such as 'OBJ' for cultural objects, 'ART' for the artworks that they represent, 'BIBL' for bibliographic records, 2) the entity to which they may be narrowly related, as it is

in the case of manifested objects, in which the first part of the ID is the identifier of the artwork in which they are recognized. Table 6.5 summarizes the ID creation rules adopted for each entity, whereas manifested subjects and recognitions are described in Table 6.6.

In order to better maintain the relation between the physical and visual instances describing an artwork, the same progressive number is used (e.g., the Artwork of the cultural object `d:OBJ1001test` is `d:ART1001text`). Furthermore, the artworks used as a test for database modeling are indicated by the suffix 'test', whereas not described cultural objects, which were added for providing more contextual information about the actually described works, have the suffix 'ext'. Those artworks included only to describe the main characteristics of a type, to which the art historians refer while describing other subjects, are identified by the suffix 'type'. These suffixes are present both in the Cultural Object ID and in the respective Artwork ID.

Table 6.5: Identifiers creation rules

Type of object	ID creation rule	Further specifications	Example
Cultural objects	'OBJ'+ <number> + eventual specification	'test': artwork used as a test case 'type': artwork solely describing a cited iconographical type 'ext': external artworks not further interpreted	d:OBJ1001test d:OBJ1005type d:OBJ1515ext d:OBJ3102
Artwork	'ART'+ <number> + eventual specification. Number and eventual specification are the same of the respective Cultural Object	'test' 'type' 'ext'	d:ART1001test d:ART1005type d:ART1515ext d:ART3102
Book	<number> + 'bibl'		d:1097bibl
Text	<number> + 'bibl' + - + 'content'		d:1050bibl-content
Production event (E12)	'PROD' + <objectID>		d:PROD1141 d:PROD1051bibl
Creation event (E65)	'CRE' + <objectID>		d:CRE1014bibl-content

Describing manifested subjects (i.e., the recognized subjects specifically as they appear in the analyzed artwork) requires a best practice to avoid entity repetition. In this case, their ID is composed of the Artwork ID (e.g., ART1001), a string identifying their type, and a progressive number. Whereas the number is inserted in the database,

the type string is added in the conversion phase.[11] As shown in Table 6.6, the string 'AM' identifies Artistic Motifs, 'COMP' Compositions, 'IMG' Images, and 'INTRINSIC' Intrinsic meanings. Similarly, Recognitions at each level are composed by the Artwork ID, followed by a string identifying their type and a progressive number.

Table 6.6: Identifiers creation rules (Manifested subjects and recognitions)

Type of object	Identifying string	Example
Artistic Motif	'AM'	d:ART1001-AM1 d:ART1512-1-AM1
Composition	'COMP'	d:ART1001-COMP1 d:ART1512-1-COMP1
Image	'IMG'	d:ART1001-IMG1 d:ART1512-1-IMG1
IntrinsicMeaning	'INTR'	d:ART1001-INTRINSIC1 d:ART1512-1-INTRINSIC1
Preiconographical Recognition	'PREICREC'	ART1001-PREICREC1 ART1512-1-PREICREC1
Iconographical Recognition	'ICREC'	d:ART1001-ICREC1 d:ART1512-1-ICREC1
Iconological Recognition	'ICONOLREC'	d:ART1001-ICONOLREC1 d:ART1512-1-ICONOLREC1
Interpretation Description	'DESC'	d:ART1001-DESC d:ART1512-DESC1

6.3.5 External vocabulary and alignment

Following the principle of interoperability, we aligned the entities to external vocabularies and identifiers when possible. According to the intended use, we adopted different strategies:[12]

- For terms intended to consistently describe the resources or identified by a unique specific vocabulary, e.g., their type or style, we directly reused the terms of a vocabulary. When the respective term in the chosen vocabulary was not found, an internal URI was created following the URI creation rules described above.
- For entities (e.g., artworks, people), an internal URI was created and aligned to external entities, when available. This approach allows an alignment of a single entity to multiple Knowledge Bases (KBs) and helps in maintaining a robust internal description.

11 the semantics in the tabular framework are already expressed by the column name

12 The code used for the alignment is made available in the project repository: https://github.com/SofiBar/IconologyDataset

- When possible, the super-class or the higher hierarchy terms of the aligned external vocabulary were retrieved. For example, when a Character was aligned to an Iconclass term, the belonging of the character to the Iconclass category was registered (e.g., 'Bible').

In the following sections, we describe each identified typology in more detail.

6.3.5.1 External vocabulary

The direct reuse of vocabulary (first case of the previous list) was adopted for the characteristics of cultural objects, namely: the type of artwork (e.g., 'oil painting'), the material and style. All of them were reconciled with the Getty vocabularies. The strategy adopted for each type is illustrated in Table 6.8. For each entity type, the hierarchy name was identified (e.g., `aat:300010357` expressing the 'Materials' hierarchy), and a string match between the database terms and the labels of the Getty's terms under the specific category was performed.

A direct reuse of current ontologies and vocabularies was attempted for cultural object relations. Despite some of them finding a respective in CIDOC-CRM (i.e., 'detail of' and 'feature of' described with `crm:P56i_is_found_on`, and part of described with `crm:P46i_forms_part_of`), the majority could potentially be aligned with Getty CONA associative relations.[13] Nevertheless, we could not reuse them, since they are not released in LOD yet.

For this reason, we provide the alignment we adopted, envisioning a better reconciliation should the CONA relations be released as LOD. Table 6.7 gives an overview of the cultural object relations, providing, if present, 1) the directly reused property from CIDOC-CRM, and 2) the possible alignment with Getty Vocabularies associative relations.

6.3.5.2 Reconciliation

The creation of an internal URI aligned with external resources was the preferred approach for the majority of the entities described. This allows one to have a stable internal definition of the uniqueness of the resources and align the same instance with multiple vocabularies.

The alignment was made through a script that checked for the entities, each time customized according to the type of object treated and the entity searched. The process followed a semiautomatic approach, as the results were then manually checked, and the accepted ones were added to the database, and linked to the correspondent entities through the relation `owl:sameAs`.

Table 6.8 provides an overview of the alignments made for each type of entity, highlighting the strategy adopted and the KBs to which they were aligned.

13 Available at: https://www.getty.edu/research/tools/vocabularies/guidelines/cona_3_5_associative_rels-copy.html

Table 6.7: Cultural object relations aligned with CONA associative relations

Dataset relation	CIDOC-CRM relation	CONA associative relation
copy of		4311 copy after
derives from		
detail of	crm:P56i_is_found_on	
feature of	crm:P56i_is_found_on	4603 incorporated in
model for		4125 model for
part of	crm:P46i_forms_part_of	4215 part of same whole
project for		4131 plan for
reconstruction of		4103 native reconstruction
reintegration of		
related to		
removed from		
study for		4115 study for
took as model		
first version of		

As the alignment of artworks was particularly challenging, due to the inconsistency with which artworks titles are registered between KBs, we aligned only those artworks having an author specified. In particular, we used regular expressions to look for entities having the same author label and containing the title in the title label on Wikidata.

Characters and Allegories were reconciled with Iconclass. Several attempts were made to set a search to retrieve the most precise number of alignments. This led to the choice of performing a fuzzy match of the character over the single keywords related to each Iconclass term. For this aim, we used the Fuzzywuzzy Python library.[14] As four types of similarity are offered, we calculated the means of all of them, setting the threshold to 95 points of similarity, over a total of 100. We adopted the same approach to calculate all the fuzzy string matching, adjusting case by case the minimum value required.

The places were aligned with Getty's Thesaurus of Geographic Names (TGN). In particular, we performed SPARQL queries in which the name of a city had to be part of the 'city' hierarchy. Furthermore, we retrieved the Country in which the city is located by indicating the type (e.g., 'Republics'). In this way, it was possible to align both cities and countries. We further extracted Wikidata's entities which are already aligned to the Getty ones through the relation `wdt:P1667`.

14 https://pypi.org/project/fuzzywuzzy/

Furthermore, we aligned people to Wikidata, specifying the type `wd:Q5`. We further extracted the respective terms on VIAF and ULAN through the alignments already expressed in Wikidata. Using a similar approach, symbols were aligned to HyperReal. To further enrich the data, the periods were manually aligned to the PeriodO period gazetteer[15] (Rabinowitz et al., 2018) and to Chronontology,[16] as they add further information about period dates and geographical area.

Table 6.8: Overview of the alignments made and matching strategy

Type	Criterion	Aligned with
Artwork	String match of artwork title and exact match of author	Wikidata
Artwork	Look for the artwork title, artist's name and surname with regular expressions	Zeri&Lode
Characters	fuzzy match with the single key words > 95	Iconclass
Places (cities with countries)/Getty	search the string with type 'city' (gvp:placeType [rdfs:label 'cities'@en]) and retrieve the country in which it is located ([rdfs:label 'republics'@en]). If the fuzzy match is > 95, add it to the dictionary	Getty
Places	Extract the Wikidata entities from the Getty ones (wdt:P1667: Getty Thesaurus of Geographic Names ID)	Wikidata
People	entity of type Q5, string search	Wikidata
People	Retrieve alignments through the already reconciled wikidata entities – wdt:P245 (ID ulan), wdt:P214 (ID viaf)	VIAF/ULAN
Material	search for a term in the 'material' hierarchy (aat:300010357) having exactly the same string	AAT
Style and Period	exact string matching with the label of a term belonging to the hierarchy 'style'	AAT
Period	manual alignment	Chronontology, PeriodO period gazetteer
Symbols	fuzzy match with symbols and symbolical meanings	HyperReal

6.3.5.3 Hierarchy of aligned objects

As subjects recognized in artworks are thoroughly described, a wide range of different instances is created, making difficult the retrieval of similarities among them. For this reason, when feasible, we retrieved the higher hierarchy terms of the aligned ones. In detail, we focused on Characters, Stories and Allegories.

15 https://perio.do/
16 https://chronontology.dainst.org/

As some characters were registered with a term identifying a specific aspect characterizing them (e.g., Venus Coelestis), the relation with the closest character (in this case, Venus) was registered through the relation `skos:broader`. The same approach was adopted for stories (e.g., the story 'An eagle tears at Prometheus' liver' is related to 'Story of Prometheus'). Some types of objects were better specified with a further retrieval of the higher hierarchy to which they belong in the aligned vocabulary. It is the case, for example, of Characters and Stories. We enriched the results by retrieving the higher hierarchy of mythological characters from Wikidata. Since they are the most represented subjects, we wanted to perform more detailed analyses on them. They were retrieved by searching for terms that were instances of (`wdt:P31/wdt:P279*`) mythological characters and classical deities or of their subclasses.

We tried to align cultural phenomena to existing classification, e.g., the Warburg's iconographical index categories. Although the index constitutes a fundamental reference point for iconological studies, an alignment to their categories doesn't help to better define the nature of each phenomenon, as it reflects the scholars's interpretations rather than providing a systematic, typological classification of cultural phenomena. For this reason, we provided a typological generalization of the cultural phenomena and their thematic core, specified as a type (`crm:P2_has_type`).

6.4 A case study description

In this section, we provide a description of a case study included in the dataset, to better illustrate the modeling decisions and description techniques adopted.[17] To this end, we present two reliefs on the external wall of Saint Mark's Basilica in Venice. In detail, we give insights into how extracting the information from the scholar's free text is conducted, how the data is inserted in a tabular database, and how they are finally represented according to the ontological modeling presented in the previous chapters.

This example is considered by Panofsky and Saxl (1933). They noticed that two reliefs (see Figure 6.9) belonging to different historical periods and representing different subjects have clearly the same shapes and general arrangement. One of them (Figure 6.9, right) is recognized by them as a late Roman one, representing the story of Hercules Carrying the Herymanthian boar, whereas the other one, from the XIII Century A.D., represents an allegory of Christ saving the Christian souls.

According to the authors' interpretation, the medieval artist used the Roman relief as a model for representing a new subject, closer to their culture. Since, during the Middle Ages, there were other cases in which a classical artwork was used as a model for contemporary subjects, deprived of its classical content, they claim that these artworks are pieces of evidence of a cultural phenomenon happening. They conclude

17 The example here described was made available as part of the ICON ontology documentation: https://w3id.org/icon/docs/

18 Images were respectively retrieved from 1) Europeana; image license: CC BY-ND; rights owner: University of Bologna 2) www.canalgrandevenezia.it; image license: CC BY-NC-SA 3.0 IT

Figure 6.9: (1) Allegory of Salvation, c. XIII A.D., Venice, St. Mark's Basilica, external wall; (2) Hercules carrying the Erymanthian Boar, III Century, Venice, St. Mark's Basilica, external wall.[18]

that Medieval Western art was unable to retain a classical prototype without destroying its original meaning since they were not capable of realizing the unity of classical form and classical subject matter. The table shown in Figure 6.10 summarizes how this content can be described at each level of interpretation.

In the Roman relief (see Figure 6.9, right), a nude man with lion skin carries on his shoulders a boar. In the lower right corner, another figure takes shelter in a barrel. At the second level of interpretation, these level 1 subjects can be grouped and recognized: the man is Hercules with his attribute 'lion skin' and the man in the barrel is King Eurystheus. The same interpretative process can be applied to the other artwork (see Figure 6.9, left), where the man is recognized as Christ, the deer as the symbol of the Christians' souls, and the dragoon in the corner is recognized as a symbol of the Devil. His actions of carrying the deer and of stepping on the Devil are respectively symbolically interpreted as the act of saving the souls and defeating the Devil. In the last level, the cultural phenomenon described above is recognized as belonging to the medieval artifact. Each level of interpretation described will be formally represented in the following sections.

6.4.1 Information extraction and subdivision into levels

As mentioned above, the process of information extraction was manually conducted. In this section, we describe how it was conducted for the selected case study. The text was read and interpreted, and the subjects identified were divided into levels. The text reproduced in Figure 6.10 is the text section in which Panofsky and Saxl focus on the description of the current case study. After the first reading, the text was interpreted through the lenses of the three-layered Panofskian approach, obtaining the identification of phrases describing the possible subjects. In the figure, the levels of

interpretation are distinguished through the use of different colors. Secondly, the type of object described, and their relations were identified (e.g., the compositions gathering level 1 objects, corresponding to a second-level subject). For example, Hercules is understood as the composition of a nude man and a lion skin. The correspondence between levels is indicated in the table by the indication of the same number. As it is possible to notice, the expression of the free text into structured data implies a more concise way of expressing the concepts (see the expression of the cultural phenomenon), and the normalization of some terms (e.g., 'drapery' became 'cloth'). The assignment of Artistic Motifs and the subject type occurs during the database population phase, described in the next section.

«[...] an antique relief of Hercules could not be imitated without changing its mythological subject. The lion's skin was replaced by a fluttering drapery, the boar became a stag, the terrified Euristheus was left out, and the hero was made to stand upon a vanquished dragon. As the human soul was often symbolized by a stag, the result of these changes was that the classical hero had been transformed into the Saviour conquering evil and saving the souls of the Faithful. From this example we learn that mediaeval Western art was unable, or, what comes to the same thing, was unwilling, to retain a classical prototype without destroying either its original form, or, as here, its original meaning.»
E. Panofsky and F. Saxl, 1933, p.228

Level	Hercules and the Erymanthian Boar	Allegory of Salvation
1	nude man with a lion skin (1) carrying on shoulders a boar (2) Man taking shelter in a barrel in the lower right corner (3)	Nude man with a cloth (1) carrying on shoulders (2) a deer (3) and stepping on (4) a dragoon in the lower right corner (5)
2	Hercules (1) Erymanthian Boar (2) King Eurystheus (3)	Christ (1) deer as symbol of souls (3) symbolic act of saving souls (2) dragoon as symbol of the Devil (5) symbolic act of defeating the Devil (4)
3		The medieval mind was incapable of realizing the unity of classical form and classical subject matter

Figure 6.10: summary of the process of the scholar's text understanding and abstraction and how this content can be described according to the three-level approach, applied to the selected case study

6.4.2 Registration in the tabular database

The record in the database is described by different tables. In the table containing the cultural object metadata, introduced in Section 6.2.2.1, the known information about the reliefs is registered. In this case, as shown in Table 6.9, we report the artwork title, date, type, location (Venice, St Mark's Basilica), specific location (external wall), the DOI for identifying the text by Panofsky and Saxl (1933), the period, the aligned URI of the second artwork retrieved from Europeana. We further include the URL of the image and the license specification. In the second place, the content recognized as belonging to different levels is expressed in the respective tables.

6.4.2.1 Artwork content interpretation

The content previously recognized as belonging to the first level of interpretation is examined, and it is established 1) which elements are the actual subjects, 2) of which type they are, and 3) which are the qualities describing them.

Table 6.9: Cultural object Table filled with the case studies metadata

Feature	Cultural Object 1003	Cultural Object 1004
ID	1003	1004
Title	Hercules carrying the Erymanthian Boar	Allegory of Salvation
Title for checking duplicates	Hercules carrying the Erymanthian Boar, III Century, Venice, St. Mark's Basilica	Allegory of Salvation, XIII Century, Venice, St. Mark's Basilica
Date	III Century	XIII Century
Type	relief	relief
Book ISBN or DOI	https://doi.org/10.2307/1522803	https://doi.org/10.2307/1522803
City of conservation	Venice	Venice
Place of Conservation	St. Mark's Basilica	St. Mark's Basilica
Type of relation	feature of	feature of
Related artwork	St. Mark's Basilica, XI-XIII Century, Venice, St. Mark's Basilica	St. Mark's Basilica, XI-XIII Century, Venice, St. Mark's Basilica
IDext	1153ext	1153ext
Specific location	external wall	external wall
Object Type	church (buildings)	church (buildings)
Period	Late Roman Antiquity	Middle Ages
URI		https://www.europeana.eu/en/item/22/_21521

First and second level recognitions. The relief representing 'Hercules carrying the Erymanthian Boar' shows, at the first level of interpretation, a man wearing a lion's skin carrying a boar on his shoulders. We know that this group of subjects will be recognized as the character Hercules at the second level of interpretation. Then, the man taking shelter in a barrel will be recognized as King Euryshteus at the second level. Lastly, the overall scene will be interpreted as the Story of Hercules carrying the Erymanthian boar to king Eurystheus. These subjects are uniquely identified as Artistic Motifs, i.e., the specific manifestation in the artwork of the subjects represented, which allows us to distinguish, for example, the man representing Hercules from the man representing King Euryshteus.

These level 1 subjects can be grouped in different compositions. A composition is a unity of artistic motifs that have a sense together, which will eventually be further recognized at the second level of interpretation. Compositions can be also used for indicating the objects involved in an action as well, and it is not required that every composition is further interpreted in the second level of interpretation. As a result, we obtain three compositions:

- composition 1: man, lion skin, action of carrying on shoulders, boar
- composition 2: man, taking shelter, barrel

- composition 3: all the Artistic Motifs identified

The first man, the lion skin, and the boar are identified as Natural Elements, grouped, with the action of 'carrying on shoulders', in composition number 1 by indicating their Artistic Motifs count separated by a '@' (see Table 6.2). Such composition will be recognized as the Character Hercules at the second level of interpretation, with the lion skin (artistic motif 2) as recognizing attribute (Table 6.3). The character of the Herymanthian Boar is directly related to the boar's Artistic Motif (number 3). Similarly, the man and the barrel are registered as Natural Elements, and, grouped with the action of taking shelter in a barrel, form the composition number 2 that will be recognized as King Eurystheus at the second level of interpretation. We included a final composition, which gathers all the Artistic Motifs previously described, that will be recognized as an Invenzione representing the story of Hercules and the Erymanthian boar. All the previously identified Characters (i.e., Hercules, the Erymanthian Boar, and King Eurystheus) are declared as part of this story.

The description of the other artwork (ART1004) takes place with the same process. The subject type was discriminated among Natural Elements and Actions, as no Expressional Quality is recognized in this case. Consequently, a composition of the Natural Elements 'man', 'cloth', and 'deer', plus the action 'carrying on shoulders', is recognized, and further interpreted at the second level as Christ. The specific motifs that compose it are further recognized. The deer (motif number 3) is recognized in Image 2 (defined in the field 'Count') as symbol of the souls, and the action of carrying on shoulders expresses the symbolical meaning of saving souls through the recognition of a symbol related to Image 3. Furthermore, the scholars described Christ as stepping on the dragoon. The act of stepping on is included in another composition with the dragoon, which is further recognized as the symbolical action of defeating the devil (image with count 4 in Table 6.12). The dragoon, recognized as a Natural Element (number 6), is identified with a symbol of the Devil (image 5). Finally, the Allegory of Salvation is assigned to a composition gathering all the Artistic Motifs, and all the second-level subjects (in this case, Symbols and Characters) are declared as part of it.
Formal Motif Recognition. Since Saxl and Panofsky claim that the artists making the medieval relief on the Saint Mark's Basilica wall copied the shape and general arrangement from the Roman one, a Formal Motif Recognition occurs. Therefore, the composition of the scene depicted by the medieval relief can be related to the composition of the classical scene. In addition, more recognitions can identify the exact correspondence between:

- Christ and Hercules
- the deer and the boar
- the dragoon and King Eurystheus
- the action of carrying on shoulders in both the artworks

Table 6.10: Expression of the recognized first-level objects in tabular format

Artwork	Artistic Motif Count	Natural Element	Quality	Action	Compo-sition	Composed By Artistic Motif
ART1003	1	man	nudity			
ART1003	2	lion skin				
ART1003	3	boar				
ART1003	4			carrying on shoulders		
ART1003	5	man				
ART1003	6	barrel				
ART1003	7			taking shelter in barrel		
ART1003	8				1	1 @ 2 @ 3 @ 4
ART1003	9				2	5 @ 6 @ 7
ART1003	10				3	1 @ 2 @ 3 @ 4 @ 5 @ 6 @ 7
ART1004	1	man	nudity			
ART1004	2	cloth	fluttering			
ART1004	3	deer				
ART1004	4			carrying on shoulders		
ART1004	5			stepping on		
ART1004	6	dragoon				
ART1004	7				1	1 @ 2 @ 3 @ 4
ART1004	8				2	5 @ 6
ART1004	9				3	1 @ 2 @ 3 @ 4 @ 5 @ 6

The relation between subjects and their part established by the recognition of a visual citation is reported in Table 6.11, which reflects the structure of the appropriate table in the database. The Roman relief (ART1003) is indicated as the artwork from which the formal motif was taken, and the Medieval one as the copying artwork (column 'to Artwork 2'). Several recognitions thoroughly describe which parts were cited. Recognition 1 expresses the citation of the arrangement of the characters Hercules and Christ and their attributes, grouped, respectively, in composition 1 at the first level of interpretation. Further recognitions establish punctual correspondence between the Artistic Motifs identifying the boar and the deer (Artistic Motifs number 3 in both the artworks), the lion skin and the cloth (number 2), the action of carrying on shoulders

Table 6.11: Expression of the visual citation performed by the Medieval relief of the Roman one

Count	from Artwork 1	Artistic Motif Count 1	Composition 1	to Artwork 2	Artistic Motif 2	Composition 2	Gives Support To
1	ART1003		1	ART1004		1	ART1004-ICONOLREC1 @ ART1004-ICONOLREC2
2	ART1003	3		ART1004	3		ART1004-ICONOLREC1 @ ART1004-ICONOLREC2
3	ART1003	4		ART1004	4		ART1004-ICONOLREC1 @ ART1004-ICONOLREC2
4	ART1003	2		ART1004	2		ART1004-ICONOLREC1 @ ART1004-ICONOLREC2
5	ART1003		3	ART1004		3	ART1004-ICONOLREC1 @ ART1004-ICONOLREC2

(number 4), and the overall arrangement of the whole scene (composition number 3). These recognitions support the recognition of the cultural phenomena identified at the last level. Therefore, the 'gives support to' column is filled with the identifier of such third-level recognitions.

Iconological recognition. As shown in Table 6.13, at the third level of interpretation, two cultural phenomena are identified: one expressing the concept in detail ('Medieval Western art was unable to retain a classical prototype without destroying its original meaning'), and the other one expressing the general classical motif recovery which is comprised in the previous one. As the phenomenon belongs to the Medieval relief, it is related only to it, while the Roman relief is indicated as the evidence supporting it.

6.4.3 Cultural Object information modeling

During the conversion, the object IDs were created from the tabular data illustrated. Consequently, from the cultural object and artwork common identification number in the database (1003, 1004), the object URI (e.g., `d:OBJ1003`), the artwork (e.g., `d:ART1003`), and the production one (e.g., `d:PROD1003`) are created.

Table 6.12: Second-level subjects recognitions expressed in a tabular format

Artwork	Count	Artistic Motif	Composition	Recognizing Attribute	Character	Symbol	Story	Allegory
ART1003	1		1	2	Hercules		Hercules and the Erymanthian Boar	
ART1003	2	3			Erymanthian Boar		Hercules and the Erymanthian Boar	
ART1003	3		2		King Eurystheus		Hercules and the Erymanthian Boar	
ART1003	4		3				Hercules and the Erymanthian Boar	
ART1004	1		1		Christ			Allegory of Salvation
ART1004	2	3				deer-souls		Allegory of Salvation
ART1004	3	4				carrying on shoulders-saving souls		Allegory of Salvation
ART1004	4		2			stepping on-defeating devil		Allegory of Salvation
ART1004	5	6				dragoon-devil		Allegory of Salvation
ART1004	6		3					Allegory of Salvation

Table 6.13: Third-level subjects recognitions expressed in a tabular format

Artwork	Count	Concept	CulturalPhenomenon	Image	Evidence
ART1004	1		Medieval Western art was unable to retain a classical prototype without destroying its original meaning		ART1003
ART1004	2		Classical motifs recovery		ART1003
ART1004	3	Redemption		1 @ 2 @ 3 @ 4 @ 5	

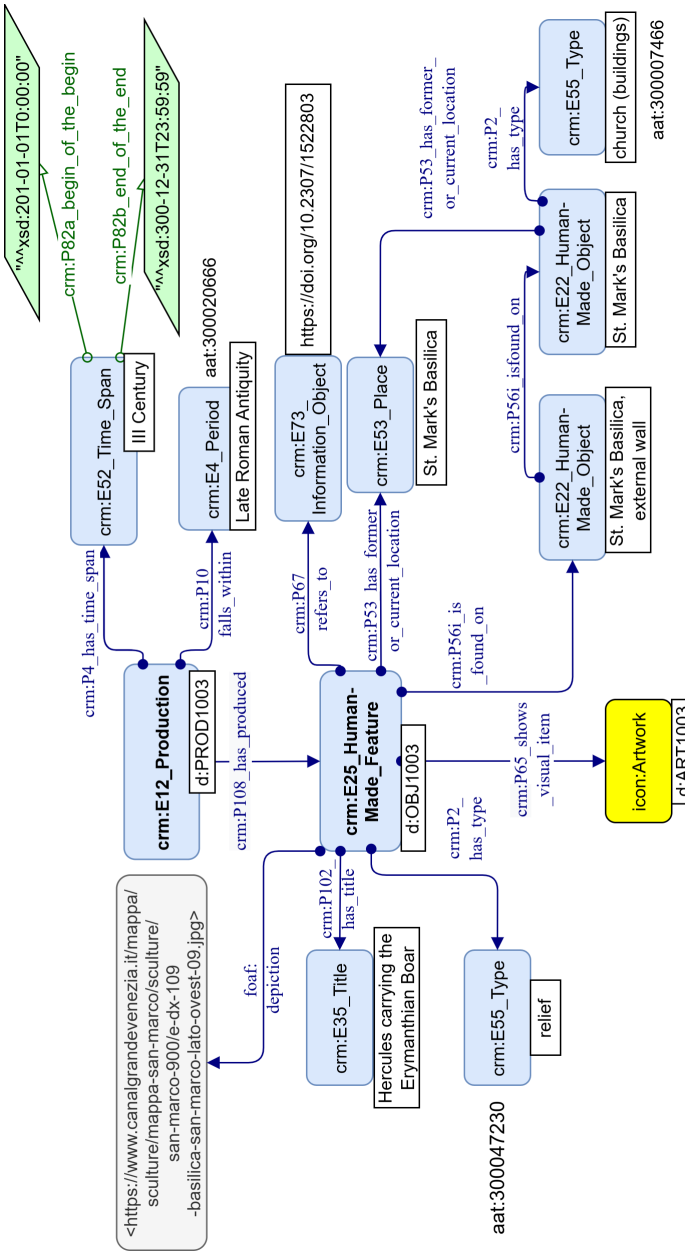

Figure 6.11: Modeling of the metadata of the Roman relief

Figure 6.11 shows how the metadata listed in Table 6.9 are converted to the RDF format. As it is registered that the cultural object is feature of the Basilica's external wall, it has as type `crm:E25_Human-Made_Feature`, which is found on (`crm:P56i`) the external wall, found on the St. Mark's Basilica. The cultural object has as type `aat:300047230`, which is the Getty's AAT term for 'relief'. Furthermore, the title (`crm:E35`), and the location (`crm:E53`) are specified, and the book on which the image is found (Panofsky & Saxl, 1933) is indicated by the relation `crm:P67_refers_to`. The time (III Century) and period (Late Roman Antiquity) are related to the cultural object production instance (`crm:E12`). From the time-span label, the beginning and end date, specified as strings, were automatically extracted.

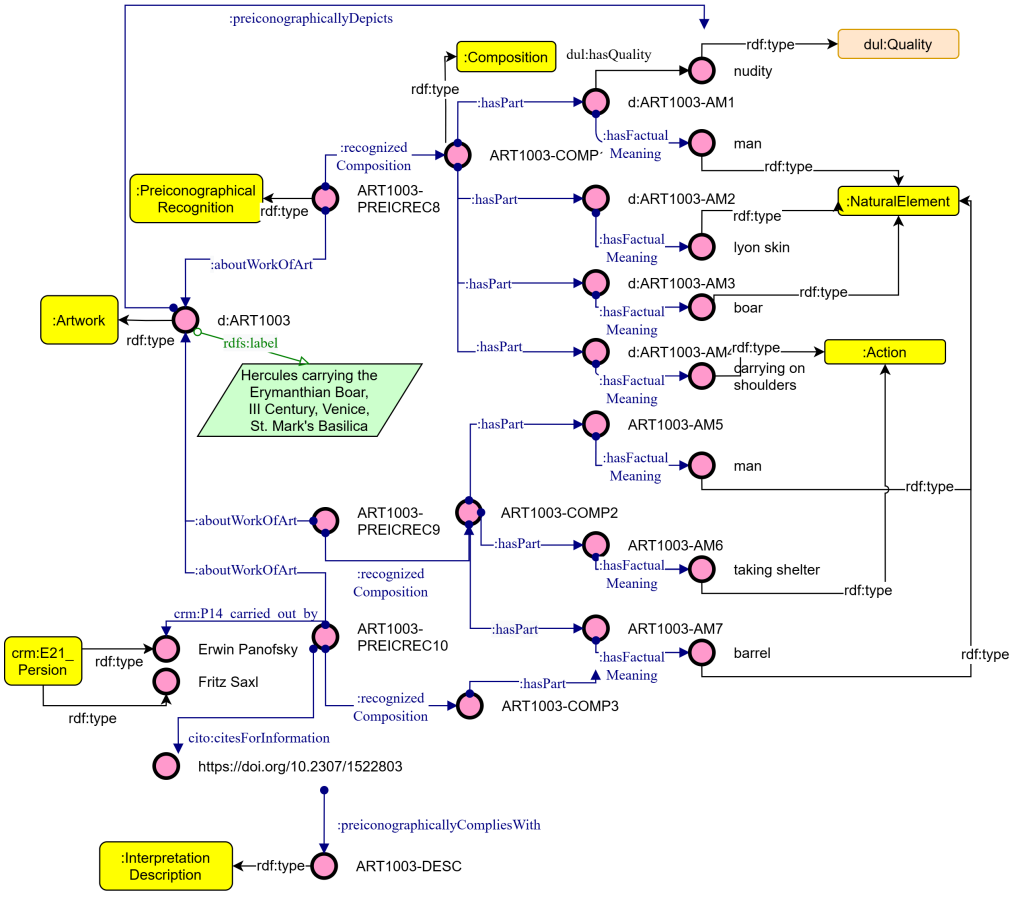

Figure 6.12: Modeling of the pre-iconographical Recognitions of the Roman relief

6.4.4 Pre-iconographical Recognition

The recognitions illustrated in Section 6.4.2.1 are modeled as shown in Figures 6.12 and 6.13. The authors Panofsky and Saxl (`crm:P14_carried_out_by`) recognize (`PreiconographicalRecognition`) a `Composition`, which is composed (`hasPart`) by `ArtisticMotifs`. The Artistic Motifs are then related to the general subjects and qualities that are recognized. For example, the quality (`dul:Quality`) 'nudity' is linked (`dul:hasQuality`) to the Artistic Motif related to the subject 'man' (`ART1003-AM1`). In this way, it is possible to affirm that only the man represented in this artwork has 'nudity' as quality, and not all the representations of 'man' in other artworks are likely to have the same quality. All recognitions are about (`icon:aboutWorkOfArt`) the artwork under examination (`ART1003`), and are declared as part of the overall interpretation ART1003DESC, having type `icon:InterpretationDescription` through the relation `icon:preiconographicallyCompliesWith`. To foster the retrieval of subjects, the property chain `icon:preiconographicallyDepicts`, acting as a shortcut, relates the artwork to the subjects recognized at the first level of recognition. The same approach can be used to describe the second relief of the example.

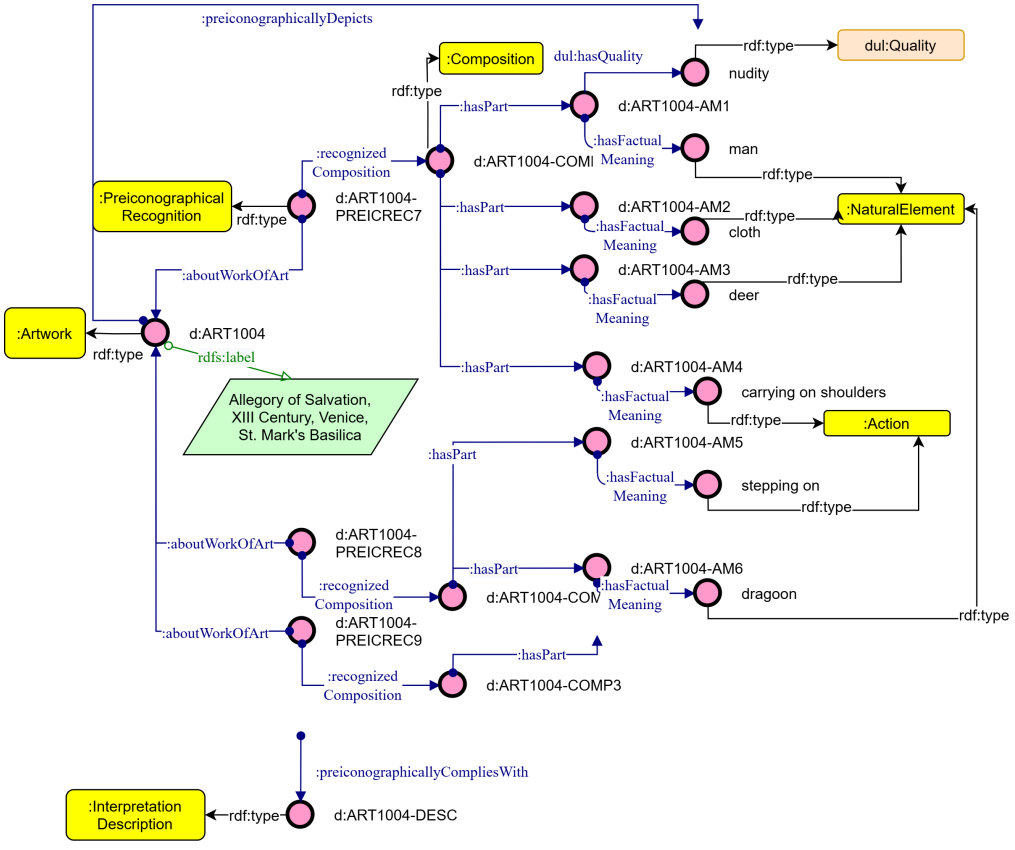

Figure 6.13: Modeling of the pre-iconographical Recognitions of the Medieval relief

6.4.4.1 Formal Motif Recognition

As shown in the scheme, each `FormalMotifRecognition` is about (`aboutWorkOfArt`) the copying artwork. In this case, Saxl and Panofsky are always the authors of the recognition. The parts of the artwork taken as a prototype (e.g., the Roman relief, here indicated as ART1003), namely Artistic Motifs and Compositions, are related to the recognition with the property `hasPrototypicalMotif`, whereas the corresponding parts of the final copying artwork (i.e., the Medieval relief) are related through the property `hasCopiedMotif`. In this way, the direct correspondence between level 1 levels can be expressed. All recognitions are listed in the `InterpretationDescription` of the copying artwork (ART1004).

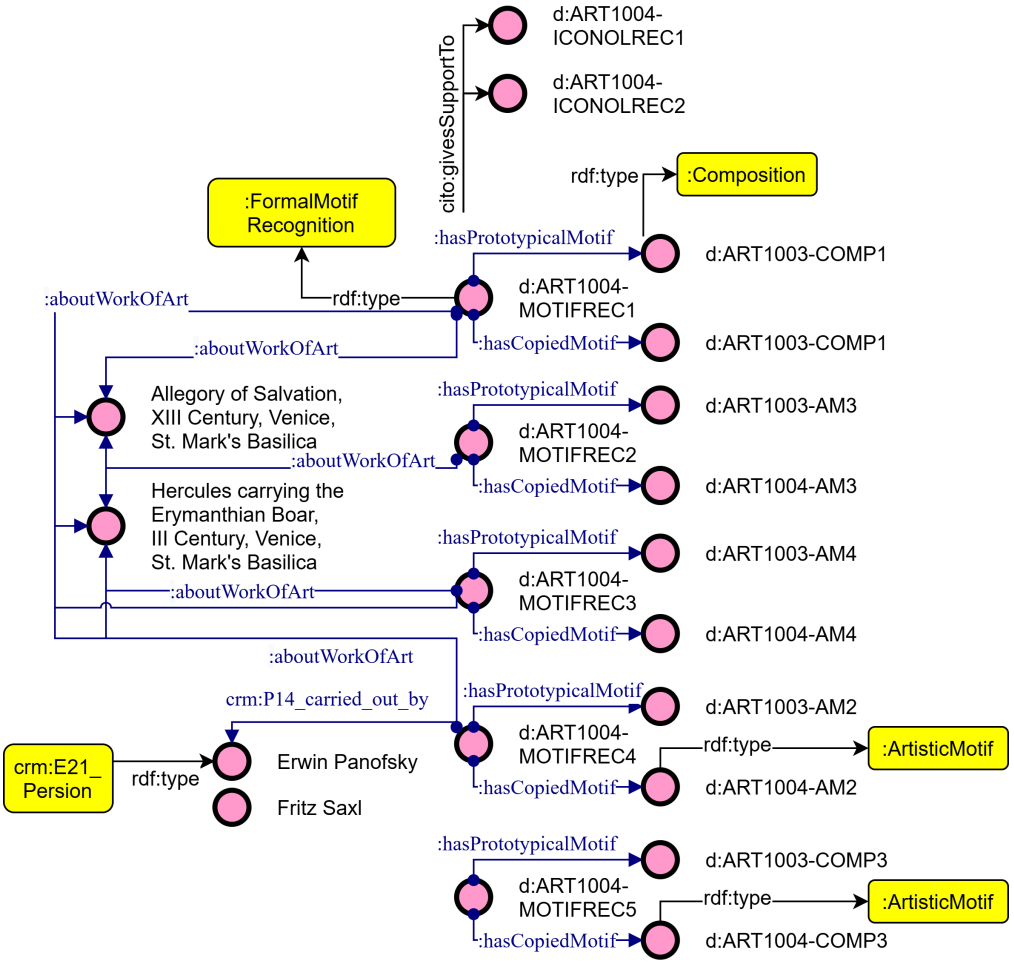

Figure 6.14: Modeling of the formal motifs Recognitions of the case studies

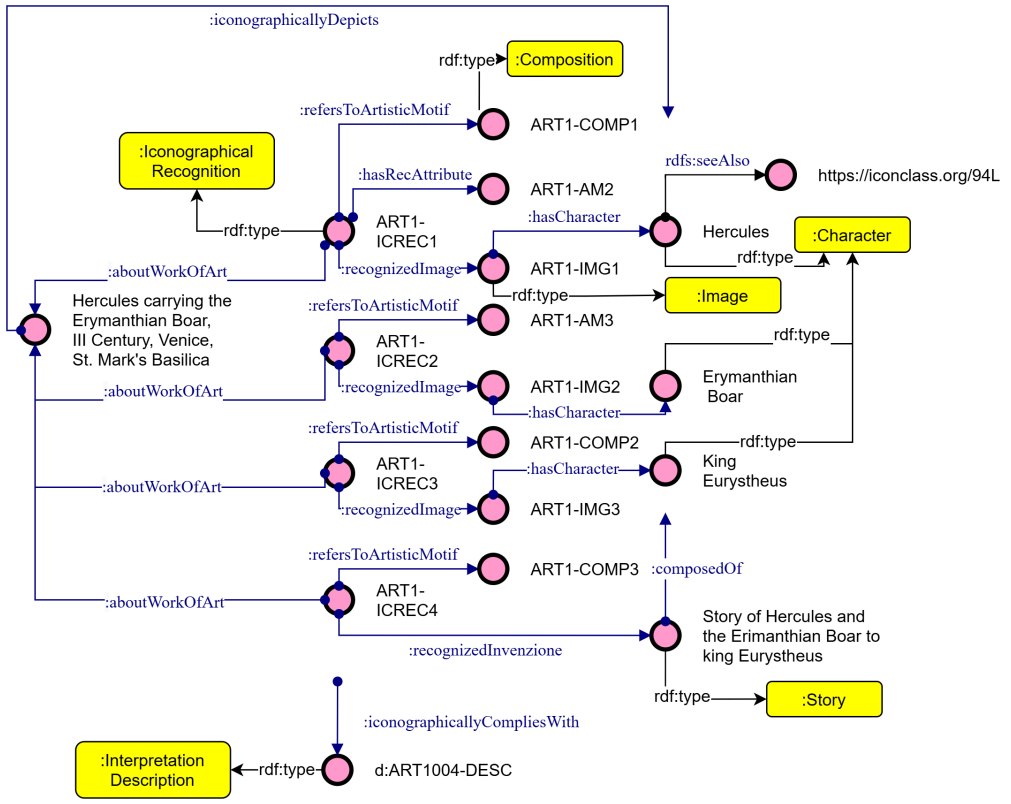

Figure 6.15: Modeling of the Iconographical Recognitions of the Roman relief

6.4.5 level 2 modeling

Each level 2 subject is identified and linked to its specific manifestation in the artwork considered, i.e., an Image. Each image can be linked to the Artistic Motifs or Compositions already identified at the first level of interpretation by means of an `IconographicalRecognition`. Each recognition links an Image or an Invenzione (i.e., Story or Allegory) to an Artistic Motif or a Composition, to create a direct correspondence between the subjects identified at each level.

In this case, composition 1 is recognized as the character Hercules, which is a character corresponding to Image 1. The Artistic Motif identifying the lion skin is related to the image by the relation `hasRecAttribute` since it is the attribute that allows character recognition. Then, Artistic Motif 3, identifying a not further defined 'boar', is linked to Image 2 and interpreted as the Erymanthian Boar, i.e., a level 2 Character. In the same way, Composition 3 is interpreted as the Character King Eurystheus. These characters are recognized as belonging to the 'Story of Hercules carrying the Erymanthian boar'. The story is then linked to the artwork and to the level 1 composition identifying the scene represented by means of another `IconographicalRecognition` recognizing the Invenzione (`recognizedInvenzione`).

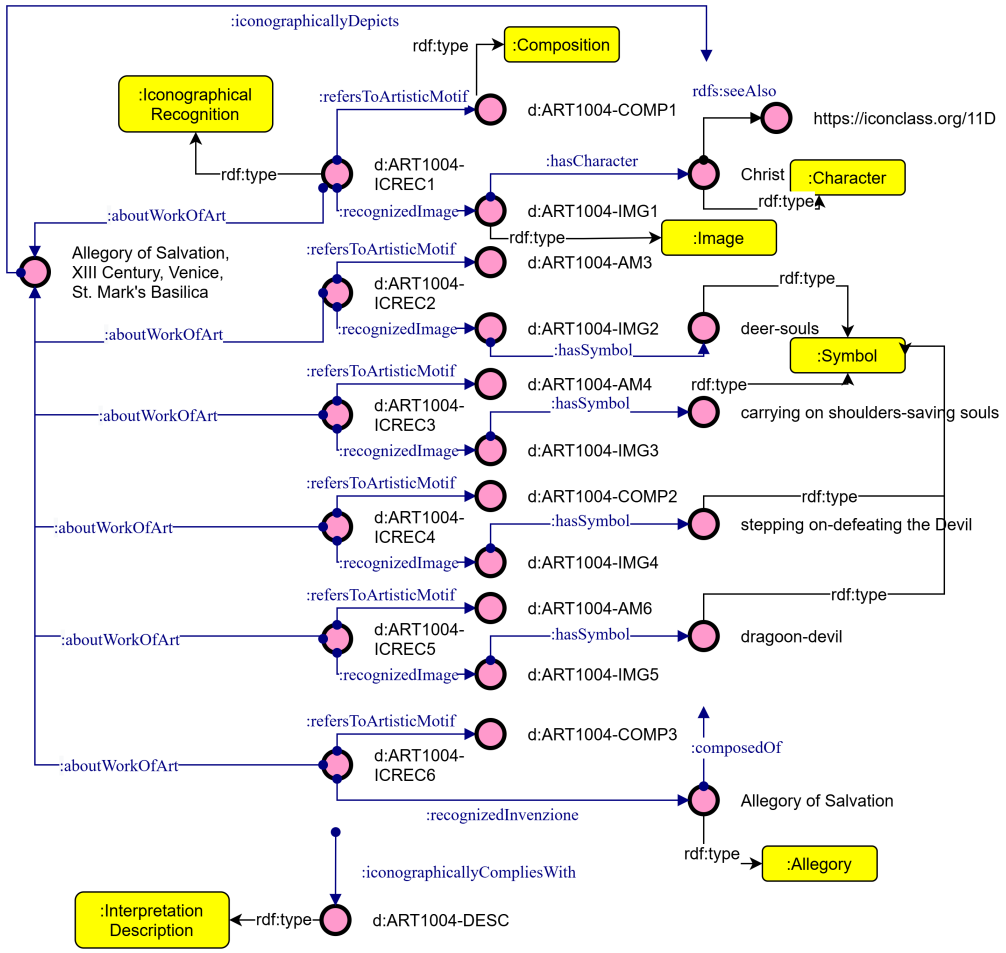

Figure 6.16: Modeling of the Iconographical Recognitions of the Medieval relief

The same structure can be applied to describe the second example. In this case, different types of second-level subjects are recognized, such as Symbols. For example, Natural Elements (deer, dragoon) and Actions (carrying on shoulders, stepping on) are interpreted at the second level of interpretation as Symbols. Finally, the composition identifying the complete scene represented is interpreted as an Allegory of Salvation, and all the second-level subjects recognized are part of it (Allegory, `composedOf`, subjects), as can be seen in the scheme in Figure 6.16. We recognize the scene as an allegory because of the presence of symbols.

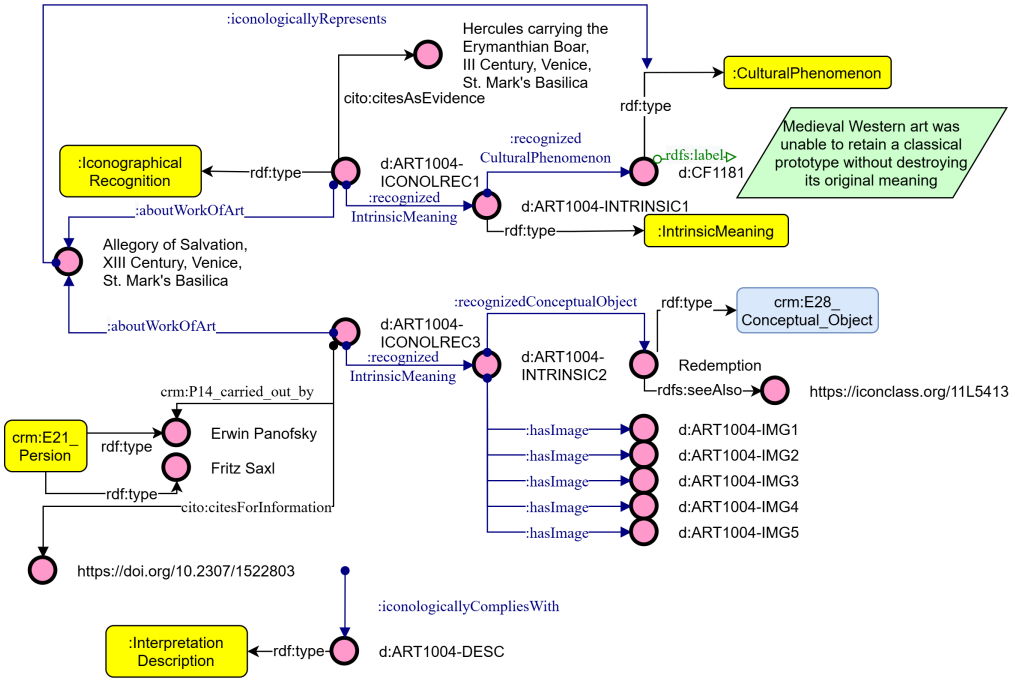

Figure 6.17: Modeling of the Iconological Recognitions of the Medieval relief

6.4.6 Level 3 modeling

In the example described, it is recognized by Saxl and Panofsky that both the artworks are involved in a common cultural phenomenon. In detail, the phenomenon regards specifically the Medieval relief, since it concerns the way in which Medieval artists deal with the Classic art. Therefore, we can say that the phenomenon is embedded in the Medieval relief, and the roman one is evidence of it.

In addition, this recognition is supported by the fact that there is a copy of formal motifs done by the Medieval artist, who took the Roman relief as a prototype for his artwork. Therefore, it is possible to affirm that the Formal Motif Recognitions made at level 1 support the level 3 interpretation, identifying the cultural phenomenon.

At the third level of interpretation, it can also be recognized that the Allegory of Salvation expresses the concept of redemption as one of the meanings belonging to Christian beliefs. Another recognition linking this more profound meaning to the artwork is considered.

This interpretative situation can be modeled as follows (see Figure 6.17). The authors make a third-level recognition, i.e., an `IconologicalRecognition`, and recognize that the Artwork representing an Allegory of Salvation has an Intrinsic Meaning (`IconologicalRecognition`, `recognizedIntrinsicMeaning`, `IntrinsicMeaning`). This Intrinsic Meaning is then linked to the `CulturalPhenomenon` of itself. The Intrinsic Meaning is indeed the specific manifestation of the general phenomenon recognized.

The Motifs Recognitions already conducted at level 1 that are described in the scheme of a Formal Motif Recognition (level 1), support this interpretation by means of the relation `cito:givesSupportTo` (see Figure 6.14). The `IconologicalRecognition`, then, cites as evidence (`cito:citesAsEvidence`) the Roman relief. Following, another iconological recognition links the artwork to another intrinsic meaning, which is related to the concept of 'redemption'. Since this interpretation can be seen in the second-level subjects, we can claim that this meaning is specifically related to them. Therefore, we link the recognition to specific images through the relation `hasImage`.