CHAPTER 5

Domain study and the ICON Ontology

5.1 Domain study

From the preliminary study in (Baroncini et al., 2021), it is clear that a simple description of the subject matter of the artwork is not enough to cover the complexity afforded by iconological studies. The aspects of complexity involved range from deeper levels of comprehension in the artwork itself to intricate relations with textual sources or comparisons with artworks depicting the same subject matter or similar features. In fact, the understanding of deeper psychological traits of the artist or the contemporaneous socio-cultural context lies in the analysis of small details and differences, as Warburg's approach points out. For a better understanding of the domain, the following sections provide the definition of its characteristics (Section 5.1.1) and interests (Section 5.1.2).

5.1.1 Characteristics of the domain

To outline the characteristics of the domain, we adopt a top-down approach from the theory of Erwin Panofsky. His systematic definition of the interpretation act is of great value for the attempt at formalization we are conducting. Nevertheless, we take into account the contributions of other art historians for important aspects of the discipline that are not included in Panofsky's theory. The initial research question (Q1.1.) can therefore be rephrased in this way: *According to Panofsky's theory, what are the items involved in an interpretation act? How do they relate to each other? How can such a theory be integrated with the relevant aspects addressed by other art historians?*

To answer this question, we examine Panofsky's theory and identify the types of entities involved along with their relations. Entities are listed with their definition in Tables 5.1, 5.2, and 5.3, while relations are represented in Figure 5.1.

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The content of the essay on which we will focus was already treated in Chapter 2, as it corresponds to the text introducing Iconography and Iconology, first published in *Studies in Iconology* (1939), and then included in *Meaning in the Visual Arts* (1955). In this section, we examine in detail the entities that the art historian describes with particular reference to the terminology he uses to identify them and the description he gives.

According to the definition provided by Panofsky, Iconology is a branch of Art History focusing on the study of **subject matter or meaning** of visual arts. This concept is central in his theory to such an extent that all the art understanding process is centered on the identification of meaning, divided into three forms. Hence, he recognizes the existence of two opposed types of meanings, namely *phenomenical* and *essential*. The former is the type to which the *primary or natural meaning* and the *secondary or conventional* belong, whereas the latter is the type of the *intrinsic meaning or content*. The three-strata nature of the interpretation act introduced in Section 2.2.2 addresses the understanding of such meanings in artworks, each according to the level.

The **primary or natural meaning** includes the *factual* and *expressional* meanings and is apprehended during the pre-iconographical description of a work of art (level 1; see Table 5.1). Such meaning is defined as of 'elementary and easily understandable nature' and is understood by relating 'certain visible forms with certain objects known [...] from practical experience' (Panofsky, 1955, p. 26). Whereas factual meanings are acquired by simply identifying visual forms with known objects, the comprehension of expressional meanings (i.e., the emotions that the recognized factual meanings may convey) takes place through empathy.

When interpreting a work of art, the visible forms that will be interpreted are the configurations of lines and colors visible on the artwork surface. Once a visual form is identified with the primary meaning and, therefore, recognized as a carrier of meaning, Panofsky calls it an *artistic motif*. A preiconographical description is consequently defined as an enumeration of artistic motifs.[1]

To consider the interpretation correct, some background knowledge is needed. Although Panofsky initially affirms that the sole common practical experience is required, he underlines that, to correctly interpret the forms visible in a work of art, the knowledge of stylistic conventions is required, namely 'the manner in which objects and events are expressed by forms under varying historical conditions' (Panofsky, 1955, p. 35).

We further introduce another aspect not addressed by Panofsky in his theory, viz., the visual arrangement of subjects, that we consider relevant to the description of this level, as suggested by Imdahl (2012), who stresses the importance of the iconic language of the image (see Section 2.2.3). Although Panofsky did not explicitly refer to it, he considers visual aspects core features of artworks understanding in some iconological interpretations (e.g., his essay on perspective as a symbolic form of different cultures [Panofsky, 1955]).

1 'An enumeration of these motifs would be a pre-iconographical description of the work of art' (Panofsky, 1955, p. 28)

Table 5.1: Definition of the entities involved in the pre-iconographical description according to Panofsky's theory (integrated with Imdahl [2012])

Entity	**Description**
Primary or natural meanings	Meanings of 'elementary and easily understandable nature'. They are recognized by relating the knowledge of objects and emotions acquired through practical experience to certain visual forms (Panofsky, 1955, p. 26). Natural meanings can be *factual* or *expressional*
Factual meanings	Primary or natural meanings that are apprehended by identifying visible forms with objects known from practical experience
Expressional meanings	Primary or natural meanings apprehended by empathy
Pure forms	Certain configurations of line and color, or certain peculiarly shaped lumps of bronze or stone
Artistic Motifs	Pure forms recognized as carriers of primary or natural meanings
Pre-iconographical description	An enumeration of the artistic motifs
Compositions	Combination of artistic motifs
Practical experience	The interpreter's 'everyday familiarity with objects and events' (Panofsky, 1955, p. 27)
History of style	'The manner in which objects and events are expressed by forms under varying historical conditions' (Panofsky, 1955, p. 35)
Visual arrangement	Visual arrangements that may exist between the depicted subjects (e.g., pyramidal structure)

A first attempt to formalize the recognition process of natural meanings is provided in Figure 5.1(a). During this act, the interpreter relates the pure forms with the natural meaning, obtaining artistic motifs. He/she makes the interpretation on the basis of his/her practical experience and the history of style.

The second level of meaning understanding concerns the second type of *phenomenical* meaning, namely the **secondary or conventional** meaning (see Table 5.2). Whereas the natural meaning was perceived through the senses, this meaning is intelligible, as it is expressed on the basis of human conventions (e.g., the Western world's conventional meaning of greeting someone by removing the hat). In addition, the secondary meaning is intentionally conveyed by the person performing it (e.g., an artist depicting a Virtue intentionally depicts it according to certain visual conventions to make it recognizable). Therefore, secondary meaning consists of specific themes or concepts that are voluntarily conveyed in visual works.

While interpreting the artwork, the observer will recognize the artistic motifs apprehended at the previous level as carriers of such secondary meanings; e.g., a visual form representing a man is recognized as Saint Bartholomew. Such recognized motifs or compositions of motifs are defined by Panofsky *images*. When images carry abstract concepts, they are called symbols or personifications. Combinations of images are *invenzioni*, which is the term used by ancient theorists to define stories and allegories. Usually, combinations of personifications and symbols can be called allegories.

Table 5.2: Definition of the entities involved in the iconographical description according to Panofsky's theory

Entity	**Description**
Secondary or conventional subject matter	Themes or concepts
Images	Motifs as recognized as carriers of secondary meanings
Personifications or symbols	Images conveying the idea of abstract and general notions
Invenzioni (Stories and Allegories)	Combination of images
Allegories	Combinations of personifications and/or symbols
History of types	'The manner in which, under varying historical conditions, specific themes or concepts were expressed by objects and events'

As the secondary meaning recognized in this level of interpretation depends on human traditions, the prerequisite for such an understanding is 'a familiarity with specific themes or concepts as transmitted through literary sources' (Panofsky, 1955, p. 35). Going further, the correctness of recognition is given by the knowledge of how such themes and concepts were visually conveyed through the depicted objects and events (Panofsky, 1955, p. 37). Such knowledge helps in the disambiguation of uncertain subjects that may be potentially referred to by multiple textual sources.

The relations among the entities participating in the second level of interpretation have a similar structure to that provided for level 1 (Figure 5.1(b)). The interpreter relates the artistic motifs or compositions recognized during the pre-iconographical description with conventional meanings, obtaining images that may be grouped into *invenzioni*. The interpretation is conducted on the basis of the interpreter's knowledge of concepts and themes from literary sources and of the history of iconographical types.

Table 5.3: Definition of the entities involved in the iconological synthesis according to Panofsky's theory

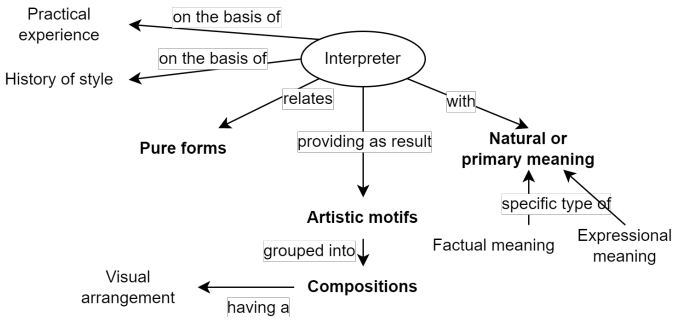
Entity	Description
Intrinsic meaning or content	'a unifying principle which underlies and explains both the visible event and its intelligible significance, and which determines even the form in which the visible event takes shape'(Panofsky, 1955, p. 28)
History of cultural symptoms	'the manner in which, under varying historical conditions, the general and essential tendencies of the human mind were expressed by specific themes and concepts' (Panofsky, 1955, p. 39)
Deeper meanings	meanings intentionally embedded by the artist (e.g., a moral message)

The last type of meaning corresponds to the essential one, recognized during the iconological interpretation (third level). As reported in Table 5.3, Panofsky defines the **intrinsic meaning or content** as the underlying principles manifested through artistic motifs, compositions, and images. Some examples of such principles are the attitude of a nation, a period, a class, or a religious or philosophical persuasion. In other words, the artwork is interpreted as a document of cultural and societal phenomena, as it is a symbol of such phenomena, which manifest themselves in the compositional and iconographical aspects of the artwork. We further partially include van Straten's position, which defines deeper meanings as those meanings voluntarily embedded by the artist in the artwork (van Straten, 2012).[2]

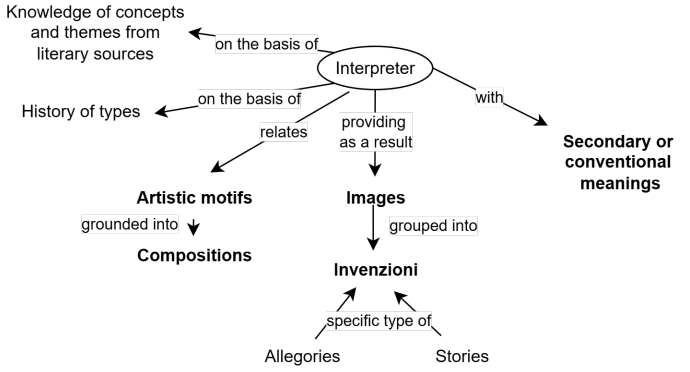
The iconological interpretation occurs through a *synthetic intuition*, an interpretative process 'based on synthesis rather than analysis.' To be correct, the interpreter must know how such socio-cultural phenomena were expressed by themes and concepts, namely the iconographical subjects identified during the iconographical description level.

Similarly to the previous levels, the relationships established by the entities that occur in the iconological synthesis can be described as follows (Figure 5.1(c)). The interpreter reads artistic motifs and images as manifestations of cultural symptoms, providing, as a result of the interpretation, the intrinsic meaning. Interpretation is carried out on the basis of synthetic intuition and knowledge of the history of cultural symptoms.

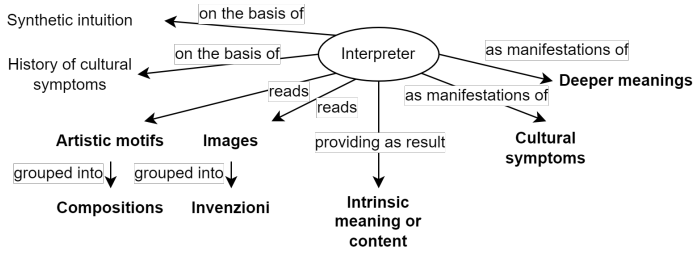
2 His definition is only partially included as, in contrast with Panofsky, van Straten recognizes the conceptual meanings of personifications and symbols as deeper meanings.



(a)



(b)



(c)

Figure 5.1: Definition of the characteristics of the domain: how the entities involved in each level of interpretation relate to each other

5.1.2 Interests of the domain

To better address possible points of interest, we extracted the questions the scholars implicitly answered in the typological selection of the literature collected in this study. The research question driving this methodology was to identify what interested the iconography and iconology domain (RQ1.2). As a result, we identified 12 questions, resumed in Table 5.4.

The following paragraphs briefly describe the studies from which the question was extracted. Since the same example can implicitly answer several identified questions, some of them are repeated. As some questions are central to the discipline and are found in many texts, we describe only one or a few cases used as examples. The questions will be conducted on the dataset created during this PhD project as part of the data analysis in Chapter 7.

Table 5.4: Overview of research questions extracted from the literature and the source

Source	**Research Question**
Cultural phenomena	
(Warburg, 1999)	Q1. Which cultural phenomena are witnessed by artworks?
(Cardini, 2001; Warburg, 1999)	Q2. Which sources and visual aspects motivate their presence?
(Panofsky & Saxl, 1933)	Q3. How does the representational evolution of subjects witness the emergence of cultural changes?
Symbols	
(Panofsky, 1955; Wittkower, 1977)	Q4. How do symbols evolve?
(Christiansen, 1986)	Q5. Is the symbolic meaning motivated by a specific source?
(Gombrich, 1972)	Q6. Is the deeper conceptual meaning motivated by sources?
Iconographies	
(Panofsky, 1955)	Q7. How do iconographies, their meaning and attributes evolve over time?
(Panofsky, 1955; van Straten, 2012)	Q8. What are the attributes allowing us to recognize a subject?
(Panofsky, 1972)	Q9. How does the representation of iconography vary?
Evidence	
(Warburg, 1999)	Q10. What were the known textual sources to which the artwork refers, and what does this knowledge tell us about the thinking of the time?
Visual citations	
(Warburg et al., 2020; Wittkower, 1977)	Q11. How do visual shapes migrate and re-appear across cultures?
(Warburg, 1999)	Q12. Is a visual citation the evidence that documents a cultural phenomenon?

5.1.2.1 Cultural phenomena

Q1. Which cultural phenomena are witnessed by artworks?
Question 1 constitutes the central question of iconological studies. As representatives of it, we cite Warburg's investigation examining the role of portraits in Renaissance Florence.

In the study *The Art of Portraiture and the Florentine Bourgeoisie* (Warburg, 1999), Warburg delves into the question of the 'effect of *milieu* on the artist', i.e., how the contemporary background influences the artworks (Warburg, 1999, p. 187). He noticed that while during the Middle Ages contemporary human beings were not depicted in the same illusionistic space of a sacred representation, during the Renaissance, there was an increasing number of representations of terrestrial patrons included in such sacred space. In particular, he analyzes the painting in the Sassetti Chapel in Santa Trinita in Florence, realized by the painter Domenico Ghirlandaio. The fresco representing the scene of the *Confirmation of the rule of Saint Francis* portrays not only the Patrons and their family members but also Lorenzo de' Medici, the most influential man in Florence of the time. To explain the massive presence of portraits not limited to the ones of the sole donors and included in the sacred space, he reconstructed the social relations of the family with the Medici and the contemporary function of portraits as votive pictures. Through the aid of 'archival and literary searches'(Warburg, 1999, p. 187), he retraces the dense network of relations between the two families. By analyzing the social value that the portrait had for the well-documented Medici family, who used to place real-size portraits of family members in the churches for votary purposes, he concludes that the massive presence of patrons' portraits in a religious art piece is not, as may appear, a violation of the sacred scene, but the proof of the evolution of the votive function of patrons' portraits.

Q2. Which sources and visual aspects motivate their presence?
It seems frequent that recognizing a cultural phenomenon is based on visual or textual sources that lead to a deeper understanding of the context.

Considering Warburg's study of Ghirlandaio's painting described above, he based the interpretation on several sources. In addition to the visual evidence (i.e., Lorenzo's portrait), the letters demonstrated Sassetti's narrow connection with the Medici family. On this basis, Warburg deepened the study of the role of votary portraits for the Medici family, finding further documentary sources about Lorenzo's real-size portraits, which were displayed in three Florentine churches. This textual evidence led to an understanding of the cultural practice of the portrait as a votary function described above. Finally, such background knowledge allowed a deeper understanding of the phenomenon witnessed in the Ghirlandaio fresco. From this example, it emerges that both visual and textual pieces of evidence are fundamental for reconstructing the sociocultural context in which the artwork was realized to understand its deeper meanings.

Another relevant example of the use of visual citations can be found in the study by Cardini of the Palazzo Vecchio's Medici Chapel. The iconography of the Magi is historically narrowly linked to the concept of sacralization of the ruler's power (Cardini, 2001, pp. 22–23). The identification of the Magi as the Byzantine Emperor John VIII Palaiologos (adult Mago), of Sigismund of Luxemburg, Holy Roman Emperor from 1433 to 1437 (elder Mago), accompanied by a young Lorenzo de' Medici (young Mago), led to the overall interpretation of the chapel as a political manifesto of the future magnificence of the Medici family. The recognition of the portrait of Sigismund of Luxemburg, which allows this interpretation, is based on a comparison with the portrait on a medal (Cardini, 2001, p.31). In fact, the young descendant of the family, depicted as the young Mago among the rulers of the Western and East Roman empires, is symbolically represented as the future ruler of the known world.

Q3. How does the representational evolution of subjects witness the emergence of cultural changes?
In studying the reception of classical antiquity in the Middle Ages, Panofsky and Saxl (1933) reconstruct the survival of classical themes and their classical visual appearance. They observed that classical subjects were depicted in an utterly non-classical manner. According to them, the reasons are twofold. On the one hand, the classical themes were transmitted through a textual tradition so that the subjects were provided without the classical appearance they had in classical art. On the other hand, the Gothic style reached a full maturity that prevented the classical themes from being depicted with a style far from the sensibility of the contemporaries. Therefore, how themes are transmitted and reinterpreted expresses the cultures that assimilate them.

5.1.2.2 Symbols

Q4. How do symbols evolve?
Wittkower provides a vast reconstruction of how the symbol of the fight between an eagle and a serpent, first found in Babylonian culture, spreads over time and place, passing through a wide range of cultures and eras, reconstructing visual and meaning variations (Wittkower, 1977). We summarize some salient passages to provide an idea of the complex and detailed reconstruction that Wittkower performs of the migration of such a symbol. According to him, the earlier evidence of a bird and a snake was found in Babylon, from which the iconography of a bird used as a solar symbol spread, reaching the East. In the Indian literature, it can be traced to the bird Garuda fighting with the snake Naga. Evidence can be found in visual representations and myths in Polinesia, Siberia, and German mythology. Furthermore, the hypothesis of migration in American cultures is affirmed since a predatory bird is present in Siberia and Alaska, analogously to the Arabian-Persian Roc, and a bird fighting with a snake is present in Mexico and Peru. Wittkower proceeds the inquiry by tracing the evolution of the symbol during the Roman, Medieval, Renaissance, and Baroque periods.

Another complex example is found in the study of Titian's *Allegory of Prudence* by Panofsky (1955), in which he traces the evolution and resemantization of the three-headed animal figures, which found their origin in the companion of the Egyptian deity Serapis. The creature, represented as three animal heads and a twisted serpent, was interpreted by the Roman writer Macrobius as a symbol of time, as the serpent was a traditional symbol of time. In the following tradition, the creature is associated with Apollo (Petrarch, *Africa*), depicted as a monster with the body of a snake, to finally become an independent symbol of time or prudence with an appearance closer to its original traits.

Q5. Is the symbolic meaning motivated by a specific source?
It is common for traditional attributes to originate in known textual sources. For example, the major part of catholic saints' attributes is the object of their martyrdom (e.g., Saint Sebastian is usually depicted as a man pierced by arrows). Consequently, it is even more reasonable that an art historian will check the literature presumably known by the artist when faced with unusual iconography. Lorenzo Lotto's painting *Venus and Cupid* (Figure 10.1), showing the two deities in a clearly symbolic scene, requires a similar investigation. To interpret it, the art historian Keith Christiansen provides citations from the classical literature explaining the possible symbolical meanings of the depicted objects. For example, the red cloth in the background of the painting is read as the proper decoration of a nuptial chamber (Claudianus, *The Magnate*). The incense had a similar function, according to Sidonius (*Epithalamium*).

Q6. Is the deeper conceptual meaning motivated by sources?
In his well-known essay on Botticelli's *Primavera*, Gombrich extensively uses textual sources to interpret the painting through contemporary Neoplatonic ideas (Gombrich, 1972). According to Vasari, Botticelli's painting was located in the villa at Castello that was built for the adolescent Lorenzo di Pierfrancesco de' Medici, cousin of Lorenzo il Magnifico. Gombrich examines some letters written by the Neoplatonic philosopher Marsilio Ficino to *Laurentius Minor*. In one of the letters, Marsilio illustrates Venus as a symbol of *Humanitas* with a moral and educational aim toward the boy. In Gombrich's hypothesis, the letter is addressed to Lorenzo di Pierfrancesco, and he supposes that such a concept inspired the realization of *Primavera* as a decoration for his villa and that Ficino and the tutors of the young Medici drew up the iconographical program for the painting. Therefore, Gombrich's hypothesis is that the painting expresses a moral and educational meaning conveyed by an iconographical program imbued with Neoplatonic concepts and ideas.

5.1.2.3 Iconographies

Q7. How do iconographies, their meaning, and attributes evolve over time?
Panofsky reconstructs the genesis of the iconography of Father Time, which, during Baroque and Renaissance, was depicted as an old, winged man with the possible attributes of scythe, hourglass, crutches, or the snake biting its tail. However, the iconographies of the two forms of time in classical culture, namely *aion* and *chairos*, are never depicted with a similar appearance. In fact, the Renaissance iconography of time is a case of *pseudomorphosis*, according to which figures with a classicizing appearance are 'invested with a meaning that, for all their classicizing appearance, had not been present in their classical prototypes' (Panofsky, 1972, pp. 70–71).

The iconography of Time derives the core traits of its aspect from Saturn, the god of agriculture, from which the old age and the sickle come. The identification of time with Saturn was favored by the similarity of their Greek names (the god Kronos and *chronos*, the word indicating time), supported by Plutarcus' indication that Kronos means time and by the Neoplatonic correlation of Kronos with Nous, the cosmic mind. Being invested with the meaning of time, Saturn acquires attributes indicating it, such as the serpent biting its tail, and the mythological episode of Saturn devouring his children is allegorically interpreted as time devouring everything. In the late Middle Ages, the sinister character of Saturn prevails, especially in his role as planetary deity. The Renaissance figure of Father-Time is the fusion of such a negative representation of Saturn with a scholastic representation of time (*Temps*), which appeared in the illustrations of Petrarch's *Triumphs* for the first time.

This type of analysis investigates the roots from which the iconography originated. In doing so, not only are its visual representations considered, but also textual sources expressing the meaning that the concept of time had in different cultures and all the concepts, iconographies, and representations possibly related to it.

Q8. What are the attributes that allow us to recognize a subject?
This question is usually raised when an observer tries to identify the subject he/she is observing, corresponding to the main practice of iconography. To this end, the attributes or details that reveal the subject matter must be identified. van Straten (2012) exemplifies the practice by reading Vermeer's *Woman holding a balance*. At first glance, a genre scene seems to be depicted, showing a woman in her daily life while weighing with a balance. However, a close examination of the balance reveals that it is empty. Parallelism with the painting representing the Last Judgement in the background is, according to Van Straten, a clue for the figure's interpretation. Since the woman weighs something invisible, the action must be symbolic. Christ, during the Last Judgement, symbolically weighs the souls of the faithful. This association allows us to read the figure as a personification of Divine Justice.

Another example in which such a question is addressed and explained methodologically is provided by Panofsky (1955) while interpreting an artwork by Francesco Maffei that presents attributes that may refer to two distinct characters, namely Salomé or Judith. The artwork shows a woman holding a sword and a basin containing a human

head. As a first step, Panofsky refers to the literature, as the Bible narrates about two women who beheaded a man, Salomé, who ordered to behead John the Baptist, and Judith, who beheaded Holofernes. According to the text, the head of John was carried on a basin, whereas the one of Holofernes was put in a bag. Although this detail would suggest that the figure is Salomé, she did not kill John herself, whereas Judith did it using a sword. As the sole literary source does not further help identify the figure, the art historian checks whether the iconography with this variation could be found in other previous examples. Whereas there are no known examples of Salomé with a sword, cases in which Judith is represented with the head of Holophernes with a basin are present. Therefore, the comparison with the iconographical tradition and the presence of iconographical types helps to identify the subject depicted in the artwork by Maffei, that is, Judith with the head of Holophernes. In this case, the art historian, to identify the depicted iconography, first looked for clues in the literature and then made a comparison with the iconographical tradition.

Q9. Does the representation of iconography vary?
This question emerges from *icon* studies in which relevance is given to the evolution of details of the iconography rather than its recognizing attributes. Our example is treated in Panofsky and Saxl (1933, p. 257). When reconstructing the origin of medieval mythography from northern France and England, they notice that, in an illustration of a manuscript from 1420[3] , the three graces are represented, but the one with her back turned is depicted on the left of the group, instead of being in the center, as shown in the classical iconographical type. The fact that medieval mythography was based on a textual tradition and no visual examples were available motivates this position change. Furthermore, the iconographical type was allegorically explained as the given favor (grace with her back turned) returned twice, which clarifies why such detail is kept in the medieval visual representation. Hence, the apparently meaningless variation of the traditional position of the graces reveals that the medieval period relied on a textual tradition of mythographical content and that a purely esthetical trait of the prototype was allegorically explained.

5.1.2.4 Evidence

Q10. What were the known textual sources to which the artwork refers, and what does this knowledge tell us about the thinking of the time?
Although many examples can be provided to highlight the relevant role that textual evidence plays in understanding deeper meanings, we will focus on Warburg's essay on Botticelli's *Nascita di Venere* (Warburg, 1999). Warburg traces the dependence on the contemporary writer Angelo Poliziano in Botticelli's masterpieces. Despite both the painting and the textual source referring to the *Homeric Hymn to Aphrodite*, the painting reflects some details of the description provided by Poliziano in his *Giostra*. In fact, among Poliziano's changes to the classical text, Warburg notes that both include

3 Illustration of Venus, cod. Vat. lat. 1290, folio 2r. available at https://digi.vatlib.it/

the presence of two *zefiri* rather than one and an accurate description of clothes and hair flying in the wind. Such detail witnesses that the painting aligns with contemporary sources in manifesting the interest in looking for the pathos in antique formulae of movement introduced in descriptive details.

5.1.2.5 Visual Citation

Q11. How do visual shapes migrate and reappear across cultures?
In the first chapter of his book, Wittkower affirms that certain artistic forms usually identified with a specific style and period can reappear in societies far in time and space (Wittkower, 1977) which have been spreading through historically documented migration routes. His analysis of the symbol of the fight between the eagle and the snake, previously described, registers how such symbols are documented from Babylonians onward, and evidence is found in Asia, Japan, Indonesia, Germany, Siberia, and America.

Another type of visual citation that he briefly explores is the influence of a visual formula that spreads in other contexts. He noticed that the visual composition Bernini adopted for his *Rape of Proserpina* (1621–22) spread in Europe, being used for other subjects such as the *Abduction of Cybele by Saturn*, *Time carrying off the Truth* (Poussin and Rubens), *Time and Opportunity* (David Le Marchand), in which the Opportunity, which is lost for the action of time passing, kills herself.

Question 11 is also the basis of a second type of study conducted by the founder of the iconological approach, namely Warburg's forms of pathos (*Pathosformeln*) elaborated in the classical period, which started to reappear in Renaissance Art to express emotional meanings. For example, he notes that a series of drawings and paintings of the Italian Quattrocento reproduce the scene of the death of Orpheus, making the hypothesis of the presence of a classical prototype copied by such artists as Dürer, Pollaiolo, and Mantegna (Warburg, 1999, pp. 553–59). They maintained the genuine classical appearance and formal composition of the prototype, which expressed the force of emotion to such an extent that the visual appearance of a classical maenad was used, in some cases, to express the despair felt by Magdalene under the crucified Christ, as can be seen in a bas-relief by Bertoldo di Giovanni representing the Crucifixion (1485–1490, Firenze, Museo Nazionale del Bargello), included in table 42 of *Bilderatlas*[4] (Warburg et al., 2020).

A further fundamental *Pathosformel* that Warburg notices is the movement of accessory elements, such as hair or clothes, agitated by air. This feature can be seen in the already introduced Botticelli *Birth of Venus*, and in paintings in which a classicizing figure with fluttering clothes is introduced in a sacred scene, as happens in Ghirlandaio *Birth of Saint John the Baptist* (1485–90), usually described as a 'nymph' from a letter written by André Jolles to Warburg (Warburg, 1999, p. 21).

4 The table is visible at https://www.engramma.it/eOS/core/frontend/eos_atlas_index.php?id_tavola=1042. The topic is deepened by Antal (1937), Wind (1937), Didi-Huberman (2017)

Q12. Is a visual citation the piece of evidence that documents a cultural phenomenon? The re-emergence of the formal type of *The Death of Orpheus* previously described witness the 'emotive, rhetorical current within the reawakening of antiquity' (Warburg, 1999, p. 553) that took place in the Early Renaissance, in drawings by Pollaiolo, Durer, and Mantegna. Rather than a stylistic borrowing, the death of Orpheus was a felt theme by contemporaries, as Poliziano's poem Orpheus witnesses. In this sense, the emotion of jealousy expressed by Orpheus beaten by the maenads is embedded in the style and visual form. The fact that the theme represented by its antique visual arrangement and style re-emerged during the early Renaissance witnesses that Italians sought in classic art 'extremes of gestural and physiognomic expression, stylized in tragic sublimity' (Warburg, 1999, p. 558).

An additional example is provided by the *phenomenon of disjunciton* registered by Panofsky and Saxl (1933): whenever the classical shape survives during the Middle Ages, it is deprived of its classical meaning. Cases can be observed in Italy and southern France, where classical artifacts were available. One example is the Roman relief placed on the external wall of St Mark's Basilica depicting a *Hercules carrying the Herymanthian boar* which is the visual prototype of an *allegory of Christ saving the Christian souls* of the XIII century (see Figure 6.9).

5.2 Requirements

Based on the analysis of the *icon* literature described in Section 2 and on the domain study in the previous section, we formulate the requirements using the SEEMP framework (Suárez-Figueroa et al., 2009).[5] The terminology was selected mainly from Panofsky's theory (Panofsky, 1955). The output document is described in Tables 5.5 and 5.6.

The purpose of the ICON ontology is to formally represent the domain of knowledge of iconology and iconography with a high level of granularity to allow specific quantitative analysis that can be interesting to domain experts. It is intended to be used by i) cultural institutions willing to publish their data about artwork content in linked data, ii) art historians interested in answering *icon* research questions in a quantitative way, and iii) developers who plan to use computer vision to associate recognized elements to portions of artworks. Therefore, the ontology aims to be implemented in different contexts, meeting the needs of different types of users. We use the OWL 2 format to make the ontology available and reusable.

5 The ICON ontology development was published in Sartini et al. (2023). Sections 5.2 and 5.3 correspond to Sections 4 and 5 of the article. Whereas S Baroncini was responsible for Section 4, the authors B. Sartini, S. Baroncini, and A. Gangemi contributed to Section 5. Section 5.3 of the current thesis was updated with the latest ontology development.

Therefore, the main non-functional requirement[6] is the reuse and alignment to the standards shared across the community to allow reusability. Furthermore, the CQs formulated for functional requirements aim to express the various aspects of the *icon* approach described in Chapter 2, Sections 5.1.1 and 5.1.2. We summarize the main themes that can be extracted from the requirements listed in Table 5.6 as follows:

1. The identification of subjects at each level of interpretation needs to be included.
2. The variations of iconographical subjects (e.g., Cupid represented with a bandage and griffon talons, rather than only with traditional attributes, i.e., wings and arrows [Panofsky & Saxl, 1933]) must be described.
3. The symbolic and cultural meanings attributed to each subject must be included.

In addition, the relevant characteristics of the approach are considered, namely:

4. The attribution must be subjective.
5. The sources used by the scholar to state its claim must be present.
6. The clear distinction between the subjects described at a general level (i.e., the background knowledge necessary for iconographical descriptions cited in Table 2.1 and in Section 5.1.1, found in standard vocabularies, describing, e.g., Cupid as a 'child with wings and arrows') and their specific manifestation in a single artwork (e.g., Cupid with griffon talons) needs to be done to allow us to describe variations.
7. The ontology must allow the integration of one claim within the agreeing claims quoted by the art historian as a source of shared and accepted knowledge.
8. The ontology must allow gathering sets of agreeing recognitions made in a coherent situation (e.g., a scholar making an interpretation in a specific paper expanding on other scholars' interpretations, therefore including their claims in his own), that may gather the interdependent recognition made at different levels (e.g., a scholar recognizes the level 2 subject 'Cupid', since s/he recognized at level 1 the subjects 'child', 'arrows', 'wings').
9. The description of the iconic language of the visual artwork needs to be included, e.g., the relative position of objects and the structure in which they are organized.
10. At least a description of the style should be included.

6 see slot 6a of the SEEMP ORSD in (Suárez-Figueroa et al., 2009)

As Panofsky's theory is considered a representative formalization of the iconological approach, we take most of the ontology terms from his theory. Therefore, we decided to populate the pre-glossary of terms (i.e., the relevant terms extracted by the CQs and their answers) contained in Table 5.6, point 7, by extracting the terms which are answering to CQs directly from the definition of his theory, on the basis of the domain characteristics defined in Section 5.1.1. The number following each word indicates the word frequency in the selected article,[7] in which Panofsky's theory is fully illustrated.

Table 5.5: SEEMP Reference Ontology Requirements Specification Document (requirements 1–5)

1	Purpose
	The ontology purpose is to formally represent the domain of knowledge of iconology and iconography with a high granularity level, to provide art historians and cultural institutions a way for expressing complex art subjects and meanings, claims about their interpretations, and interlinking among them.
2	Scope
	The ontology focuses only on the *icon* interpretations that can be made about the content and meaning of visual artworks. The ontology has a high level of granularity, to correctly represent i) specific data important for domain experts and ii) the subjectivity of each claim.
3	Implementation language
	The ontology has to be implemented in OWL2 language.
4	Intended End-Users
	User 1. Cultural institutions that have a detailed bibliography about artworks looking for a formal language to express it User 2. Art history scholars with complex research questions only answerable with quantitative methods or wanting to express the data they collected in a formal language User 3. Developers using computer vision to associate recognized elements to portions of artworks
5	Intended Uses
	Use 1. Publish structured data about artwork interpretations online and integrate them with existing data to enhance the query potentiality of the cultural institutions' data Use 2. Conduct a specific and detailed quantitative analysis to answer research questions in the domain research field Use 3. Provide a semantic structure for knowledge extraction

5.3 Modeling

The ontology modeling (version 2.1) was achieved through an initial development made following the SAMOD methodology (Sartini et al., 2023) and three subsequent extensions aimed at improving its coverage and efficiency (Baroncini & Sartini, 2024; Sartini & Baroncini, 2023). Following, we describe the modeling of the current version of the ontology (2.1) according to its main aspects.

7 For this analysis, we referred to the article 'Iconography and Iconology: an introduction to the study of Renaissance art' published in (Panofsky, 1955) since it is the last revised version published.

Table 5.6: SEEMP Reference Ontology Requirements Specification Document (requirements 6–7)

6	**Ontology Requirements**
6.a	Non-functional Requirements
	NFR1. The ontology must be based on international standards and, when possible, directly reuse them
6.b	Functional Requirements: Groups of Competency Questions
	CQ level 1 CQ 1.1 What level 1 objects are represented in the artwork? CQ 1.2 What objects are natural elements, expressive characteristics, or actions? CQ 1.3 What level 1 subjects are formally derived or copied from other artworks' level 1 subjects? CQ 1.4 In what compositional structure are the objects organized (e.g., pyramidal arrangement)? **CQ level 2** CQ 2.1 What level 2 subjects are identified in each artwork? CQ 2.2 Retrieve, respectively, all characters, events, personifications, named objects, and places recognized at level 2. CQ 2.3 In which story or allegory are the depicted subjects involved? CQ 2.4 Do the level 2 subjects have a symbolic meaning? CQ 2.5 Which is the object that allows character recognition at level 2, i.e., the character's attribute? CQ 2.6 What are the representative variations at level 1 of the same level 2 subject in different artworks? CQ 2.7 What are the level 1 variations of the same level 2 subject involved in different stories or allegories? CQ 2.8 What are the level 1 subjects having multiple interpretations at level 2? Which of them are made in the same descriptive situation? **CQ level 3** CQ 3.1 What meanings are expressed by the artworks? CQ 3.2 What cultural phenomena are identified? CQ. 3.3 Who identified the cultural phenomena and on which basis? CQ 3.4 What are the artworks involved in the same cultural phenomenon? CQ 3.5 To which specific subjects at level 1 and 2 does the level 3 recognition refer? CQ 3.6 What are the artworks having both a common cultural phenomenon and a common level 2 subject? **General CQ** CQ 0.1 What are the sources that support each subject recognition at each level? CQ 0.2 What is the person responsible for every recognition at each level? CQ 0.3 What are the artworks that are only interpreted on a pre-iconographical level? CQ 0.4 What works of art are interpreted on an iconological level but not on an iconographic one? CQ 0.5 What are the subject recognitions motivating another recognition? Of what type are they? CQ 0.6 What artworks or parts of them have a style associated?
7	Pre-Glossary of Terms (Term, Frequency in studied documents)
	Motif(s) 44; Story(ies), 37; Image, 26; Interpretation, 22; Natural, 16; Iconography, 15; Iconographical, 14; Allegory(ies), 11; Intrinsic meaning, 9; Preiconographical Description 9; Iconographical Analysis, 8; Composition, 7; Expressional, 7; Artistic motifs, 5; Factual, 5; Iconological Interpretation, 4; Iconology, 4; *Invenzioni*, 1

5.3.1 Recognitions and interpretations

As explained in Chapter 2 and in Section 5.1.1, works of art can be analyzed through different layers of interpretation according to the type of recognition made. A recognition, in the context of this ontology, is an interpretation act made by an agent (or interpreter, which can be a biological or electronic being) that links works of art to something related to their content. From a conceptual perspective, it is a mental entity reflecting the agent's subjective point of view. From a technical viewpoint, it is an N-ary predicate that cannot be modeled using OWL due to expressivity limitations; therefore, it was turned into an N-ary relationship class.[8] Coherent recognitions on the same artwork, composing the actual interpretation, are collected and documented by interpretation descriptions (requirement 8, Section 5.2).[9] In this section, we conceptualize the elements that revolve around recognitions, illustrated in Figure 5.2.

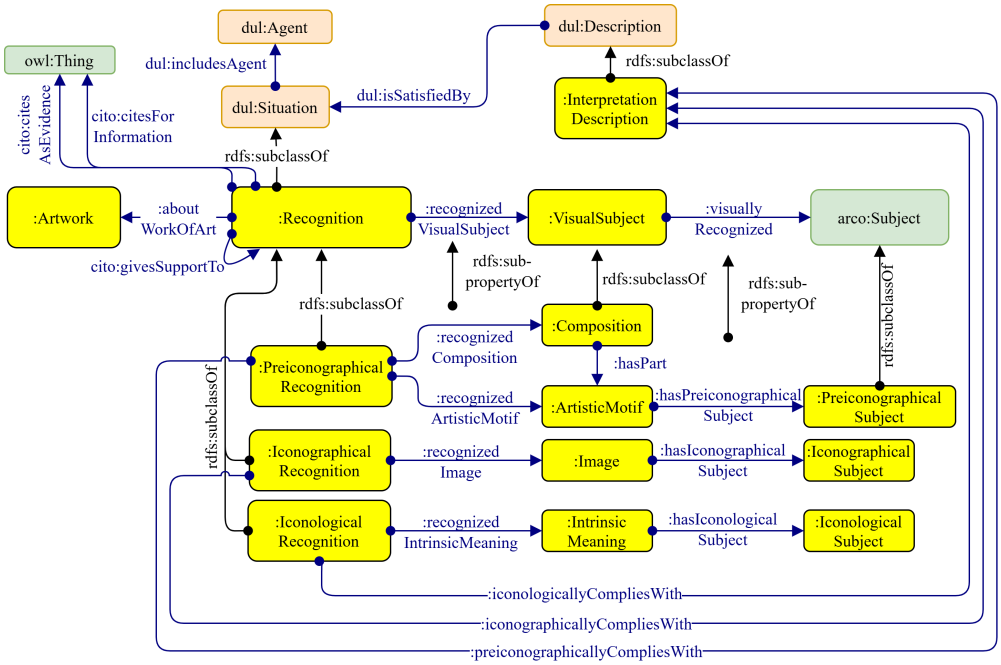


Figure 5.2: Overview of the main ICON ontology classes and properties linked to recognitions

From the n-ary relationship class `icon:Recognition`, several properties were designed (or reused from existing ontologies) to link it to its interpreter(s) (or agents), the artwork that is being interpreted, the subject identified, and supporting sources for the recognitions. In particular, the `aboutWorkOfArt` property links the recognition to the

8 More observation on the matter can be found in Subsection 5.4.

9 The distinction between the mental entity of the recognition and the document entity of the description is necessary not only because a description can contain multiple recognitions, but also as a way of separating through coherent criteria different recognitions made on the same artwork (even by the same interpreter). For example, an art historian, while interpreting, can agree with the statements of other art historians and include them in his/her own interpretation, or provide different interpretations over time.

artwork (`Artwork` class). Each `Recognition` identifies a subject as manifested in the artwork, namely, a `VisualSubject`, through the relation `recognizedVisualSubject`. The `VisualSubject` is in turn related to an `arco:Subject` through the property `visuallyRecognized`, a class identifying generally defined subjects that can be reproduced in different artworks (e.g., the terms specified in iconographical vocabularies, i.e., Iconclass). Such distinction allows descriptions of details of recognized subjects uniquely present in the artwork under observation (e.g., the fact that the character Cupid has the wings of a certain color in the observed artwork). The pattern is further specialized at each level of interpretation through subclasses and sub-properties, as illustrated in the following sections. Then the `dul:includesAgent` property (from DOLCE [Gangemi et al., 2002]) links the recognition to the agent who performed it (requirement 4, Section 5.2). The class `InterpretationDescription` is linked to (one or many) `Recognition` class(es) that comply with it through the relation `dul:isSatisfiedBy`, connecting a `dul:Description` with a `dul:Situation`, namely, an ontology design pattern present in the DOLCE+ DnS Ultralite ontology, to which ICON is aligned, which represents the adopted view on a relational context described according to a theory.[10] We specialize the reused pattern in further subproperties according to the type of the recognition, namely: `isCompliantWithPreiconographicalRecognition` for pre-iconographical recognitions and formal motif recognitions,[11] `isCompliantWithIconographicalRecognition` for iconographical recognitions, `isCompliantWithIconologicalRecognition` for iconological recognitions. The CiTO (Shotton, 2010) properties `cito:citesForInformation` and `cito:citeAsEvidence` can be linked to an `icon:Recognition` class to provide sources or other information that support a recognition (requirement 5, Section 5.2). Finally, a recognition can also be used to support further recognitions made on the same artwork or another one. For example, Panofsky recognizes that the figure of Chastity sculpted by Giovanni Pisano on the Pulpit of the Pisa Cathedral is represented with the same appearance as the classical nude iconography of Venus Pudica (formal motif recognition).[12] This interpretation supports the third-level recognition of the characteristics of the Proto-Renaissance movement in the cultural context of Medieval Tuscany (Panofsky, 1972, p 157). To express this using our ontology, the property `cito:givesSupportTo` can link the supporting recognition to another one (requirement 7, Section 5.2). These elements are also the object of interest of the general competency questions (see Table 5.6, Q0.1 to Q0.5).

Depending on the level of interpretation presented in Table 2.1, four `Recognition` subclasses have been defined:

10 A Description represents a conceptualization, and it can be read as a descriptive context "that uses or defines concepts in order to create a view on a 'relational context' (cf. Situation) out of a set of data or observations. For example, [...] a Diagnosis is a Description that provides an interpretation for a set of observed entities". Retrieved from: http://www.ontologydesignpatterns.org/ont/dul/DUL.owl

11 Both a pre-iconographical recognition and a formal motif recognition are described in the first level of pre-iconographical interpretations of Panofsky, so we use the same property to link them to the `InterpretationDescription` class

12 Figure available at https://www.wga.hu/art/p/pisano/giovanni/pulpit_p/3column5b.jpg

- `PreiconographicalRecognition` (level 1)
- `FormalMotifRecognition` (level 1)
- `IconographicalRecognition` (level 2)
- `IconologicalRecognition` (level 3)

Recognitions at each level of interpretation may be based on the results of the recognition at one of the previous levels. Therefore, they can be linked together, but ultimately are modeled independently of one another. This choice is made since i) the describer may not have available the descriptions of the lower level(s), ii) the corresponding subjects in the other levels may not be relevant for the recognition, iii) it may be possible that a level 3 recognition (i.e., an `IconologicalRecognition`) is linked to level 1 subjects rather than level 2 ones (e.g., iconological interpretations of a landscape painting, which may not have level 2 subjects [Panofsky, 1955]).

Furthermore, some real-world art descriptions don't always provide rich, complex information about artwork subjects and content. For this reason, the ontology allows the description of artworks at different levels of detail. For each granular path that connects a subject to a visual one, which is then related to the artwork through a recognition, property chains[13] create shortcuts, allowing direct links between artworks and their respective first, second, and third level of interpretation subjects,[14] respectively:

- `preiconographicallyDepicts` for the first level of interpretation
- `iconographicallyDepicts` for the second level of interpretation
- `iconologicallyRepresents` for the third level of interpretation

By leveraging these super-properties, the ontology meets the requirements of ontology usability by museum institutions, which may be interested in a lighter description of artwork content when little information is given. At the same time, it fosters information retrieval when a detailed description is required, i.e., for expressing complex interpretations by Art History scholars. As the properties are defined as property chains, they can be inferred through the use of a reasoner when a thorough description using the ontology classes and properties described above is provided. The level-specific classes that specialize the upper classes and properties introduced here and their usage will be described further in the following subsections.

13 https://www.w3.org/TR/owl2-primer/#Property_Chains

14 The addition of property chains is fully described in the ontology extension published in (Sartini & Baroncini, 2023)

5.3.2 Pre-iconographical Recognitions (level 1)

In the Pre-icongraphical level (i.e., level 1), an interpreter recognizes artistic motifs present in the artwork,[15] and associates to them preiconographical subjects i.e., i) natural objects (a tree, a man, a sword) without identifying specific individuals from those classes which are recognized in level 2 (e.g., tree of life, Saint Joseph, Excalibur; see Section 5.3.3), ii) expressional meanings[16] (emotions of the depicted elements), iii) qualities about these elements (size, colour, position, role, quantity), iv) performed actions. Assuming that the agent doing the interpretation act might also be a computer, as in the case of the results of object detection through computer vision, we give the possibility to express the coordinates of the portion of the image of the artworks where these elements are detected. These coordinates can also be expressed using IIIF URIs (Snydman et al., 2015) that point to a specific portion of the work of art. A series of artistic motifs can be grouped together in a composition that can have a compositional structure[17] (e.g., pyramidal). Additionally, an interpreter might recognize similarities between artistic motifs present in a work of art with other artistic motifs of another work of art, recognizing a prototypical artistic motif or composition that is reused in another artwork. For example, the level 1 description of Pisano's figure of Chastity cited above is linked through a formal motif recognition to the level 1 description of Venus Pudica, from which its appearance is derived (i.e., a nude woman covering herself with her arms). Artistic Motifs and compositions are linked to the class `PreiconographicalRecognition`, which represents recognitions occurring at the first level of interpretation (see Figure 5.2), respectively through the properties `recognizedArtisticMotif` and `recognizedComposition`. Only one artistic motif or composition can be linked to a recognition. Compositions are linked to the artistic motifs that take part in them through the `hasPart` property. Each artistic motif is then related to the recognized `PreiconographicalSubject` through the property `hasPreiconographicalSubject`, further specialized in sub-properties according to the type of subject recognized. If the artistic motif refers to a natural object or action with a factual meaning, it is linked to the classes `NaturalElement` or `Action` through the property `hasFactualMeaning`. Otherwise, if what is recognized in the artistic motif is an expressional meaning, the property that links it to expressional meanings is `hasExpressionalMeaning`. If preiconographical subjects have some specific qualities that need to be highlighted, it can be done through enriching the artistic motif with the DOLCE `hasQuality` property. As some qualities frequently occur in figurative art representations, the ontology specializes the class `dul:Quality` with two subclasses, `Material` and `Color`, to describe these features of the subject depicted. Further properties allow a granular description of the identified subject, namely, a data property to indicate the quantity with which a subject appears

15 namely, visual forms recognized as carriers of a pre-iconographical meaning; see Section 5.1.1

16 according to Panofsky, the expressional meanings are the subjects that can be interpreted at the first level of recognition through empathy (Panofsky, 1955, p. 27)

17 The compositional structure conceptualization is derived from Imdahl's theory (Imdahl, 2012)

(e.g., “two” wings or a “multitude” of people) and the role covered by the depicted subject (e.g., “goldsmith”). When the pre-iconographical recognition is performed by a computer with an object detection algorithm, or when a IIIF URI is provided, it is possible to associate not only the detected objects, but also the coordinates of the image in which they are found. Coordinates of the detected object can be expressed through the data property `hasRegionDescription` which has the `ArtisticMotif` or `Composition` classes as the domain. As mentioned above, the use of IIIF URIs for the format of this data property is also welcome. The `FormalMotifRecognition` class links the prototypical motif or composition to the copied motif, respectively, using the `hasPrototypicalMotif` and `hasCopiedMotif` properties. All the coherent formal motif recognitions and pre-iconographical recognitions that take part in an interpretation about a work of art can be linked to an `InterpretationDescription` class through the property `preiconographicallyCompliesWith`. Finally, the shortcut `preiconographicallyDepicts` links the `Artwork` to the recognized level 1 subjects, as it is expressed as a property chain of `aboutWorkOfArt`, `recognizedArtisticMotif` or `recognizedComposition`, and `hasFactualMeaning` or `hasExpressionalMeaning` or `crm:P138_represents`. These chains come into play when the elements of the first level of interpretation are identified either through the recognition of an artistic motif or as part of a recognized composition. Listing 5.1 represents the property chain axioms in Manchester syntax. Figure 5.3 shows a graphical rendering of the classes and properties used in this level of interpretation.

Listing 5.1: Definition of the chain "preiconographically depicts" in Manchester syntax

```
hasRecognition o recognizedArtisticMotif o hasExpressionalMeaning

hasRecognition o recognizedArtisticMotif o hasFactualMeaning

hasRecognition o recognizedArtisticMotif o crm:P138_represents

hasRecognition o recognizedComposition o hasPart o hasFactualMeaning

hasRecognition o recognizedComposition o hasPart o
hasExpressionalMeaning

hasRecognition o recognizedComposition o hasPart o
crm:P138_represents
```

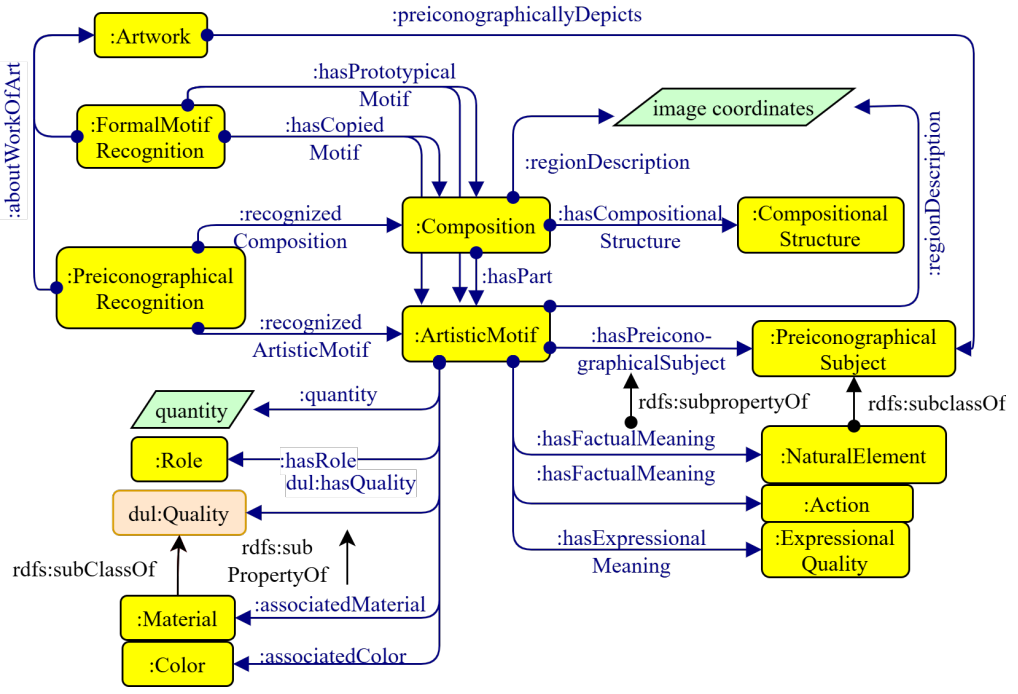


Figure 5.3: ICON ontology classes and properties describing the pre-iconographical level of interpretation (level 1)

5.3.3 Iconographical Recognitions (level 2)

In this section, we describe the modeling of Panofsky's second level of art interpretation: the Iconographical interpretation. In this level, the interpreter recognizes images and *invenzioni*[18] in an artwork. An image, a subclass of `VisualSubject`, represents the subject depicted as a manifestation in the specific artwork taken into account. It is then linked to second-level subjects, namely characters, places, events, named objects,[19] symbols, and personifications, which identify iconographies from an abstract and general point of view. An *invenzione*, instead, is the subject matter represented by the combination of general subjects linked to the single images recognized.[20] For example, a viewer might recognize three images in an artwork: the first refers to the

18 Invenzione is an Italian word used by Panofsky as an umbrella term for allegories and stories (Panofsky, 1955, p. 59); see Section 5.1.1

19 A named object is a non-living unique element that is often used as an attribute for the recognition of specific characters (Thor's hammer.)

20 This definition slightly differs from Panofsky's: while he describes an *invenzione* as a form expressing the subject represented by the combination of the single images recognized, we consider it as an individual belonging to the 'sphere of secondary or conventional subject matter, viz., the world of specific themes or concepts manifested in images' (Panofsky, 1955). This decision is motivated by the fact that, the description of real case studies in the modeling phase, emerged that it would be redundant to general stories and allegories both at the conventional level and their manifestation in the specific artwork. Their variations are already clear, considering which subjects are part of them in each particular case.

general subject of Mary, the second refers to the general subject of the Angel Gabriel, and the third refers to the general subject of the Holy Dove. The combination of the general subject of Mary, the Angel Gabriel, and the Holy Dove is the Annunciation, which, in our ontology terms, would be considered the *invenzione*. The same *invenzione* could be present in multiple artworks, but each artwork maintains its uniqueness by having different images. The classes `Story` and `Allegory` are subclasses of the class `Invenzione`. Stories are more likely to contain characters, named objects, places, and events, whereas allegories are more likely to contain symbols and personifications. We give the possibility to express symbols as just symbolic meanings recognized, or, for a more thorough description, as Simulations (see Section 5.4). The classes `Image` and `Invenzione` are linked to the class `IconographicalRecognition` through the respective properties `recognizedImage` and `recognizedInvenzione` (one image or *invenzione* per recognition). Intra-level links with the pre-iconographical level can be established by relating the recognition of an image with an artistic motif or composition through the property `refersToArtisticMotif` (e.g., the recognition of the image that represents Mary Magdalene can be linked to the artistic motif that has the factual meaning of woman). This link is important to ensure that the connection between pre-iconographical elements and the respective iconographical subjects is preserved. If the artistic motif is the principal element that enables a recognition of an image, then it can be linked to that image through the property `hasRecAttribute` (i.e., the recognition identifying Cupid has as recognizing attributes the artistic motifs linked respectively to “wings" and “arrows"). Images are linked to the general subject portrayed (i.e., an `IconographicalSubject`) through the property `hasIconographicalSubject`. Further subclasses and subproperties specialize the pattern according to the subject identified, as shown in Figure 5.4. Such ICON classes represent second-level subjects represented in the fictional representational space, therefore including both real and fictional, non-existent subjects (e.g., Medusa, the Greek mythological character appearing in various media), in compliance with the modeling of subjects in narratology (Bartalesi et al., 2017; Ciotti, 2016; Damiano & Lieto, 2013). Among them, `Place`, `Event`, and `NamedObject` represent subjects having their own identity, a distinctive aspect from level 1 Natural Elements (e.g., the battle of Cascina, the city of Bologna, and the book of the Bible). If a subject is depicted in a specific role (e.g., St. Luke depicted as a painter), the information can be represented through the property `hasRole`. An *invenzione* is linked to the iconographical subjects that compose it through the property `composedOf`.

Multiple iconographic recognitions that take part in an interpretation of an artwork are linked to the interpretation using the `iconographicallyCompliesWith` property. Finally, the property `iconographicallyDepicts` links an artwork and a second level of interpretation element that the artwork represents. It is made a super property of a chain that connects an artwork to instances of classes defining characters, symbols,

Listing 5.2: Definition of the chain " iconographically depicts" in Manchester syntax

```
hasRecognition o recognizedImage o hasCharacter

hasRecognition o recognizedImage o hasPersonification

hasRecognition o recognizedImage o hasEvent

hasRecognition o recognizedImage o hasPlace

hasRecognition o recognizedImage o hasSymbol

hasRecognition o recognizedInvenzione

hasRecognition o recognizedImage o hasNamedObject

hasRecognition o recognizedInvenzione o composedOf
```

personifications, places, events, named objects, stories, and allegories (including their stories and allegories components). Listing 5.2 represents the property chain axioms in Manchester syntax. Figure 5.4 shows the classes and properties relative to this level of recognition.

5.3.4 Iconological Recognitions (level 3)

Iconological interpretations (third level) focus on the recognition of intrinsic meanings.[21] An intrinsic meaning links the whole artwork or some parts of it to a cultural phenomenon or a concept that defines it. The `IconologicalRecogniton` class is linked to the `IntrinsicMeaning` class through the property `recognizedIntrinsicMeaning`. From there, the n-ary class `IntrinsicMeaning` can be linked to a specific composition, image or artistic motif that can be the focus of the intrinsic meaning through the properties `hasComposition`, `hasImage`, `hasArtisticMotif`. Then, it is linked to the recognized `IconologicalSubject` through the property `hasIconologicalSubject`. The third-level subject recognized can be either a general concept or a cultural phenomenon, defined as subclasses of `IconologicalSubject`. Two sub-properties of `hasIconologicalSubject`, namely `recognizedConcept` and `recognizedCultural-Phenomenon`, respectively relate them to the intrinsic meaning. For expressing generic, deeper concepts, we reuse the DOLCE class `SocialObject` because there was no need to create an ad-hoc class for this element.[22] Currently, the class `CulturalPhenomenon`,

21 Even if Panofsky's terminology seems to prefer the term *symbolic values* for expressing the interpreted third-level aspects of the artwork, we decided to adopt the term 'intrinsic meanings' to avoid confusion with the second-level symbols.

22 The concepts, ideas, abstract elements that are linked to intrinsic meanings on an iconological level are very broad (Panofsky, 1972). Therefore, we decided to reuse this DOLCE class (Social Object) which conceptualises a broad set of possible entities (Gangemi et al., 2002)

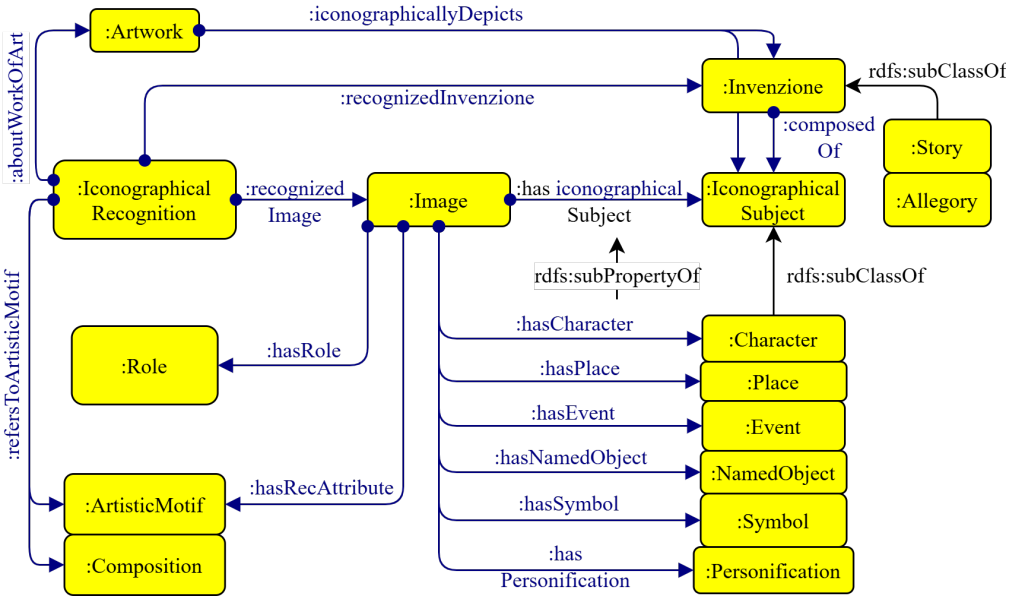


Figure 5.4: ICON ontology classes and properties describing the iconographical level of interpretation (level 2)

identifying specific socio-cultural phenomena that the artwork witnesses, has four subclasses, which specify the type of cultural phenomenon, namely `Attitude`, `Belief`, `CulturalValue`, and `Tendency`. These terms are taken from Panofsky's vocabulary in the description of the third level of artistic interpretation.[23] All the iconological recognitions that take part in an interpretation made on an artwork are linked to it with the property `iconologicallyCompliesWith`.

The property chain `iconologicallyRepresents` acts as a shortcut linking the artwork directly to the third-level subjects recognized, fostering the information retrieval and providing a lightweight means of iconological descriptions. This property serves as the super property of a chain connecting an `Artwork` to instances of either `CulturalPhenomenon` or `dul:SocialObject` classes.

Listing 5.3 represents the property chain axioms in Manchester syntax. A graphical rendering of the modeling of the third level of the interpretation can be found in Figure 5.5.

23 Although these subclasses could be formally associated with mental entities just as recognitions, they differ in their function. Recognitions are modelled on a meta level of the interpretation, as they are used to describe a recognition act made by an interpreter. These subclasses are meant to be the object of the interpretation, as they are associated with the recognition of an intrinsic meaning of the artwork itself.

Listing 5.3: Definition of the chain of the superproperty "iconologically represents" in Manchester syntax

```
hasRecognition o recognizedIntrinsicMeaning o
    recognizedCulturalPhenomenon

hasRecognition o recognizedIntrinsicMeaning o recognizedConcept
```

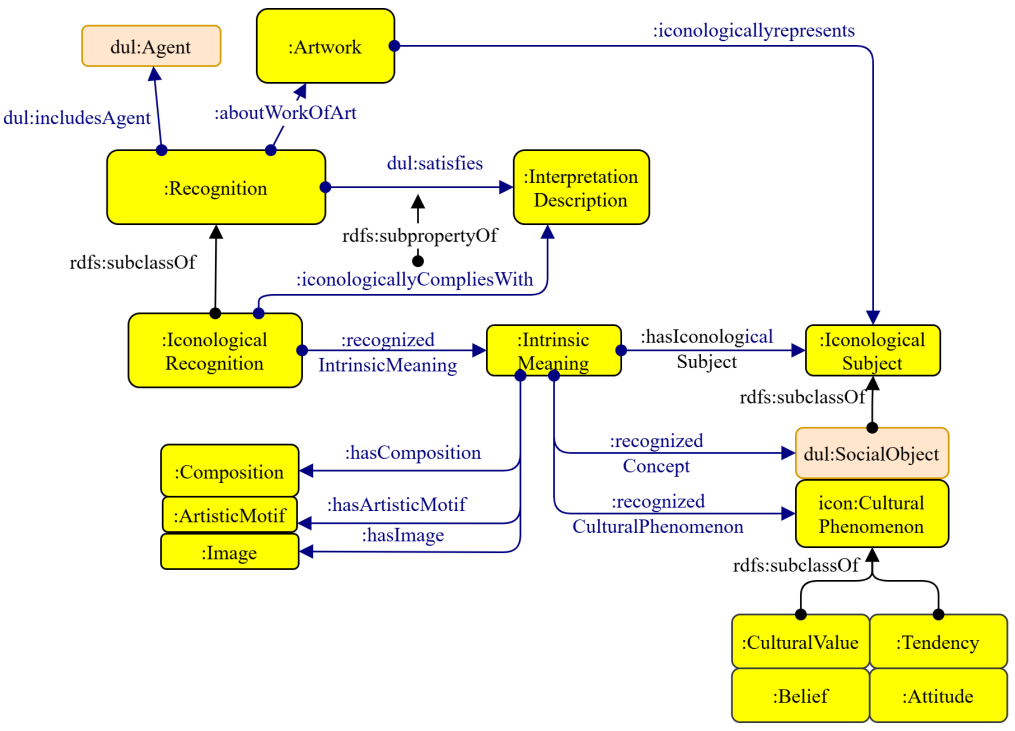


Figure 5.5: ICON ontology classes and properties describing the iconological level of interpretation (level 3)

5.4 Refactoring: reuse and alignment to relevant ontologies and ontology design patterns

To promote ontology interoperability and reusability, we connect to several external ontologies through means of alignments and reuse, made by following guidelines proposed by the state of the art (V. Carriero et al., 2020; Osman et al., 2021). Our ontology selection for reuse and alignment was guided by different principles: (i) standardization for CIDOC-CRM (Bekiari et al., 2021) and FRBRoo (Riva & Zumer, 2017) because they are considered standard frameworks in the domain, (ii) cognitive and formal analysis for the choice of DOLCE foundational ontology (Borgo et al., 2022; Gangemi et al., 2002) in its OWL version (DOLCE Zero), Simulation Ontology (Sartini et al., 2021), VIR (Carboni & de Luca, 2019) HiCO (Daquino & Tomasi, 2015) and CiTO (Shotton, 2010) as all of them offer design solutions to the competency questions defined from the requirements in Section 5.2.

Due to the complexity of the field, the number of ontologies to be reused, and the heterogeneous domains from which they come, we adopted a hybrid reuse approach (V. Carriero et al., 2020), which, depending on the specific cases explained below, considers either reusing directly the classes and properties of the aforementioned ontologies (either by importing the whole ontology or parts of it), or (indirect reuse) using them as fully extensional ontology patterns, or just as intensional patterns.

Extensional reuse happens when classes or properties of an ontology $O1$ are logically *aligned* to an external ontology $O2$, which we want to reuse with its full-fledged semantics because it is compatible, desirable, or necessary. For example, if we extensionally align a $O1$ class `Organisation` to a $O2$ class `dul:SocialObject`, we intend to inherit the semantics of DOLCE's social objects, e.g., that they are not physical.

On the contrary, we use parts of an external ontology $O3$ as purely intensional constructs when we want limited interoperability, which does not include accepting in $O1$ all the semantics provided in $O3$, because it may be partly incompatible. For example, we may intensionally align a $O1$ class `Image` to a $O3$ class `crm:E36_Visual_Item` because we might not want to inherit the axiom stating that `crm:E36_Visual_Item` is a subclass of `crm:E89_Propositional_Object`.

In order to implement this distinction, indirect reuse is designed using different mapping properties, according to the semantics they provide, and its impact into the resulting reasoning. We have used RDFS (`rdfs:subPropertyOf`, `rdfs:subClassOf`) and OWL (`owl:equivalentTo`) logical properties when we want the alignments to provide first-order extension to ICON schema and data, while we have used SKOS `skos:broadMatch`, `skos:related`, and `skos:closeMatch` for purely intensional mapping, which can be used at query time to integrate data represented with ontologies that may harm the logical integrity of ICON knowledge.

Among the reused ontologies, we have used an intensional (or 'terminological') mapping for CIDOC, VIR and FRBRoo, because we have noticed potential problems when reasoning is jointly made with both the axioms from ICON, and from those ontologies. For example, a full extensional alignment of the class `Image` as `rdfs:subclassOf` `crm:E36_Visual_Item` would make an automated reasoner infer that `Image` `rdfs:subclassOf` `crm:E89_PropositionalObject`, which is not defendable, since propositional entities typically exclude visual, musical, or other information modalities. In other words, CIDOC contains here a debatable assumption, which should be ignored when reusing data that use CIDOC as their schema. Now, if we use a purely intensional mapping: `Image` `skos:broadMatch` `crm:E36_Visual_Item`, we make a commitment that can be discussed, and the triple can be used to make SPARQL-based data integration, but we will not get the inference that images are propositions.

In this section, we give a thematic overview of the classes and relations reused for satisfying a specific task, and we refer to the documentation for further details on the single alignments. Table 5.7 shows the direct reuse of external classes and properties in ICON, and Table 5.8 shows the indirect alignments.

Table 5.7: Direct Reuse of Classes and Properties in ICON

External Element	Type	Ontology	Usage
Agent	Class	DOLCE	represents interpreter (with dul:includesAgent property)
Quality	Class	DOLCE	represents recognized quality of artistic motifs (linked from icon:ArtisticMotif with the dul:hasQuality property)
SocialObject	Class	DOLCE	used as the symbolic meaning linked to an icon:IntrinsicMeaning class through the property icon:recognizedConcept
includesAgent	Property	DOLCE	links icon:Recognition to the agent (dul:Agent) performing it (also a non-human agent)
givesSupportTo	Property	CiTO	links icon:Recognition to another icon:Recognition that supports it
citesAsEvidence	Property	CiTO	links icon:Recognition to an entity (owl:thing) that is the evidence on which the recognition is based
citesForInformation	Property	CiTO	links icon:Recognition to an entity (owl:thing) that is the source in which the recognition is found (e.g., a bibliographical reference)

Recognitions as situations. According to the guidelines of eXtreme Design (Presutti et al., 2009), we defined our local problem (in our local space) as the expression of recognitions through N-ary relationship classes due to the inability of expressing N-ary predicates in OWL. As explained in the previous paragraphs, our conceptualization of the `icon:Recognition` class required a good deal of contextual information (such as the agent performing it, what is recognized in the form of first, second, or third level

Table 5.8: Indirect Reuse of Classes and Properties in ICON: icon element – type – external element

External Element	Type	Ontology	ICON Element	Type of alignment
E5_Event	Class	CIDOC	Action	skos:broadMatch
E36_Visual_Item	Class	CIDOC	Artwork; ArtisticMotif; Composition; Image; IntrisicMeaning	skos:broadMatch
InformationObject	Class	DOLCE	Artwork	rdfs:subClassOf
E13_Attribute_ Assignment	Class	CIDOC	Recognition	skos:broadMatch
InterpretationAct	Class	HiCO	Recognition	rdfs:subClassOf
Situation	Class	DOLCE	Recognition	rdfs:subClassOf
Description	Class	DOLCE	InterpretationDescription	rdfs:subClassOf
Simulation	Class	Simulation Ontology	Symbol	owl:equivalentTo
F38	Class	FRBRoo	Character	skos:broadMatch
E1_CRM_Entity	Class	CIDOC	ExpressionalQuality; Invenzione; NaturalElement	skos:broadMatch
E31_Document	Class	CIDOC	InterpretationDescription	skos:broadMatch
E90_Symbolic_Object	Class	CIDOC	Symbol	skos:broadMatch
IC11_Personification	Class	VIR	Personification	skos:closeMatch
Subject	Class	ArCo	Character; Personification; Event; NamedObject; Place; Symbol; Invenzione; Action; NaturalElement; ExpressionalQuality	rdfs:subClassOf
E89_Propositional _Object	Class	CIDOC	Event; NamedObject; Place	skos:related
P138_represents	Property	CIDOC	hasCharacter; hasEvent; hasExpressionalMeaning; hasFactualMeaning; hasNamedObject; hasPersonification; hasPlace; hasSymbol	skos:broadMatch
P140_assigned _attribute_to	Property	CIDOC	associatedForm; refersToArtisticMotif	skos:broadMatch
P141_assigned	Property	CIDOC	recognizedArtisticMotif; recognizedComposition; recognizedImage; recognizedInvenzione	skos:broadMatch
P106_is_composed_of	Property	CIDOC	hasPart	skos:broadMatch
K4_is_visual _prototype_of	Property	VIR	hasCopiedMotif; hasPrototypicalMotif	skos:broadMatch

of interpretation entities, the artwork). We have chosen the situation ontology design pattern[24] as a solution because it was designed to solve modeling issues regarding multiple contextual information connected to the same class in the form of n-ary relationships. The Situation ontology design pattern is reused via the import of DOLCE Ultralight.[25] The n-ary relationship ODP is specialized by our `icon:Recognition` class, by making it a subclass of `dul:Situation`.

Interpretations as descriptions. The types of recognitions that we have presented are formalized as situations. In the Descriptions and Situations pattern[26] that is also formalized in DOLCE-Ultralight and DOLCE Zero, situations are loosely associated with *descriptions*, i.e., intensional entities that are used criteria for a situation to occur. The pattern is used in most domains: in medicine, a pathological situation depends on the diseases or syndromes that are used to interpret it, and which can have different probabilities to correspond to the actual situation; in Law, different norms may apply to a same legal case; in an everyday situation, an observer may interpret it differently according to his/her perspective, culture, or intention. In the *icon* domain, as also applied in the ArCo ontology network (V. A. Carriero et al., 2019, 2021), all recognitions and high-level interpretations are based on perception criteria, which make a rationale emerge, and eventually motivate a particular interpretation with respect to others. A description is therefore a conceptual entity, constituted by parameters, roles, tasks, etc. (Gangemi & Mika, 2003), which is satisfied by a situation when it involves entities that are classified by one of the parameters, roles, tasks, etc. that constitute a description. For example, the interpretation of a painting (Named A) such as 'in this painting, there is a lion which symbolizes courage' is compliant with (i) a pre-iconographical recognition (recognizing an artistic motif as a carrier of the factual meaning of a lion), and (ii) an iconographical recognition (recognizing the image of the lion as the simulation of lion-courage). These recognitions would involve the recognizer, a source, the time period, as well as (potentially) additional iconographical aspects. Hence, we formalize this complex relation in terms of compliance: `InterpretationDescriptionPaintingA isCompliantWithPreiconographicalRecognition LionRecognitionInA` and `isCompliantWithIconographicalRecognition LionCourageRecognitionInA`. The property `isCompliantWithPreiconographicalRecognition`[27] is made a sub-property of `dul:isSatisfiedBy` which links a `dul:Description` (our `Interpretation-Description` is subsumed under description) to one or more `dul:Situation` (our `Recognition` is subsumed under situation).

24 http://www.ontologydesignpatterns.org/cp/owl/situation.owl

25 The aforementioned ODP was reused through the DOLCE Ultralight ontology because the Situation class in DOLCE is linked to other classes that are reused in our ontology as well, such as the agent.

26 http://www.ontologydesignpatterns.org/cp/owl/descriptionandsituation.owl

27 The properties `isCompliantWith PreiconographicalRecognition` and `isCompliantWith IconographicalRecognition` are the inverse properties of `preiconographicallyCompliesWith` and `preiconographicallyCompliesWith` shown in Figure 5.2

Describing artwork content. Since CIDOC CRM offers a way of describing the content of visual elements (`crm:E36_Visual_Item`, `crm:P138_represents`, `crm:E1_Entity`), we modeled the more specific elements recognized in each level of interpretation following this modeling principle as a guideline, and aligning our classes to CIDOC's ones through SKOS relations. As illustrated by Figure 5.6, all the classes representing the general subject as represented in the contest of the artwork (i.e., Artistic Motif, Composition, Image, IntrinsicMeaning) are a `skos:broadMatch` of `crm:E36`. Furthermore, the recognized subjects at every level are a `skos:broadMatch` of `crm:E1_Entity`. In this way, the patterns linking the visual elements recognized in each level and the general subject can be seen as a specification of `crm:P138`. Identification of the artwork at the abstract level (Artwork, `skos:broadMatch` of `crm:E36_Visual_Item`) is intended to make the ontology compliant with the CIDOC-CRM modeling of cultural objects, whereas the alignment of Artwork with `dul:InformationObject` is motivated by the DOLCE conceptualization of the Information Object that fits our Artwork definition. Similarly, we declare a match between the recognized subjects and a CIDOC-CRM class, when available. In this way, `icon:Action` is aligned with `crm:E5_Event`, for including also actions not directly made by human beings. `icon:Event`, `icon:NamedObject` and `icon:Place` are aligned with `crm: E89_Propositional_Object`, as such subjects may describe real or imaginary places, following the solution adopted by Schneider et al. (2021, p. 11).

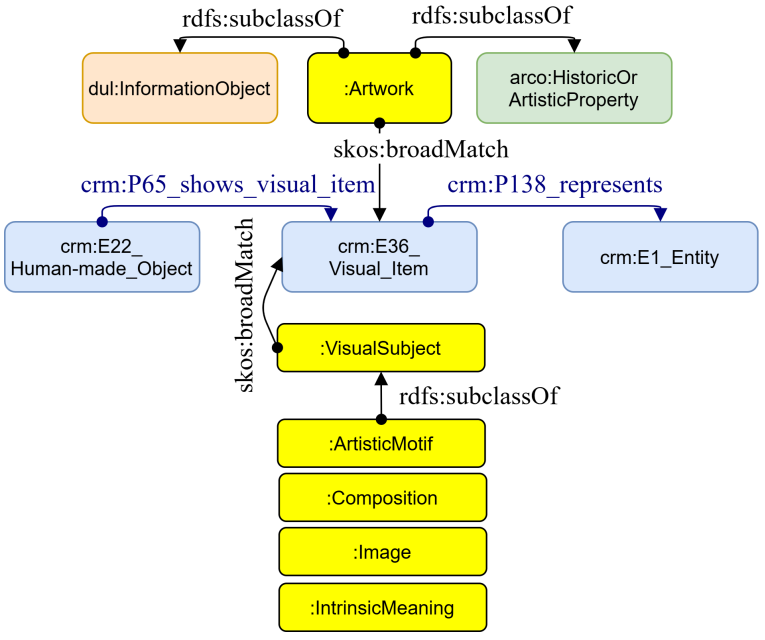


Figure 5.6: Alignment with other ontologies of the artwork description

Interpretation details. The class Recognition has been aligned with classes from HiCO, CIDOC-CRM and DOLCE, as shown in Figure 5.2. The class hico:InterpretationAct is intended to represent the context in which a recognition[28] is made, i.e., furnishing more information about the recognition to validate the claim. The recognition such represented can be further specified by hico:interpretationType and hico:Interpretation-Criterion. For its purpose and formal structure, icon:Recognition was made a subclass of it. Since also the purpose expressed by crm:E13_Attribute_Assignment is of documenting the context in which an assertion about a cultural object was made, it is a skos:broadMatch of Recognition, as Recognition is more specific than the more generic concept expressed by crm:E13. Furthermore, crm:E13 is practically used as an n-ary relationship class linking two individuals through ancillary properties, crm:P140, crm:P141, identifying respectively the element to which the assignment is made and the assigned one. Therefore, when this logical structure is respected, the respective properties in the subclass of icon:Recognition are aligned to crm:P140 and crm:P141 through skos:broadMatch. Respectively, RecognizedArtisticMotif or RecognizedComposition at level 1, RefersToArtisticMotif and RecognizedImage or RecognizedInvenzione at level 2.

By the alignment with hico:InterpretationAct, and dul:Situation, the ontology not only enhances interoperability but also inherits a variety of means for expressing further detail about each recognition act at each level. For example, the possibility to express an agent using dul:Agent which includes both humans and computers, the time of the recognition using the includesTime property of DOLCE, the interpretation criterion[29] InterpretationDescription class and type (HiCO) allows the user to fully document the recognition acts, giving a comprehensive representation of the subjectivity of the recognition itself.

The Motif Recognition is developed as a specialization of the VIR property K4i_has_visual_prototype, documenting the use of a visual prototype for an image, enriching the latter by giving the possibility to add further details about the interpretation and to highlight the direct correspondence between the portions of the copying and copied artworks. For example, the derivation of the visual arrangement of the relief *Allegory of salvation* from the Roman relief depicting *Hercules and the Erymanthian Boar* described by Panofsky and Saxl (1933, p. 228), shown by Figure 6.9, can be further described by recognizing that the deer in the former is derived from the boar in the latter, and so on. Our property icon:hasPrototypicalMotif was aligned with skos:broadMatch to K4_is_visual_prototype_of.

28 In the context of this study, since we align hico:InterpretationAct to Recognition, we refer to it with the term *recognition* for the clarity sake

29 in the case of our ontology, interpretation criterion is linked to every single recognition, and not with the interpretations

Subjects. As it is the closest definition of artistic subject intended as an object represented by an artwork, we align all the subjects of the ontology to the ArCo's class `arco:Subject`. Specifically, we indirectly reuse `arco:Subject` by subsuming `icon:Place`, `icon:NamedObject`, `icon:Character`, `icon:Event`, `icon:Symbol`, `icon:Personification`, `icon:Action`, `icon:NaturalElement`, `icon:ExpressionalQuality`, `icon:CulturalPhenomenon`, `icon:Invenzione`, `dul:SocialObject` to it. In doing so, we also propose a new way of attributing a subject to a work of art compared to ArCo. In fact, while ArCo directly links a subject to the physical representation of the work of art, we link it to an interpretation made on the visual representation of what is in a physical work of art. By reusing the class `arco:Subject` and not its properties, which consider the physical artwork as the domain, we also avoid possible logical inconsistencies between ArCo's description of physical artefacts and ICON description of visual items. In contrast, the representation of the subjects as manifested in the artwork (i.e., Artistic Motifs, Compositions, Images, and Intrinsic Meanings), are subclasses of `icon:VisualSubject`, which is disjoint with `arco:Subject` to underline their different nature and role. Table 5.9 displays the division between subjects and visual subjects according to the different *icon* levels.

Table 5.9: Distinction between subjects and visual subjects depending on Panofsky's levels of interpretation

Subject	**Visual Subject**	**Level**
Action	Artistic Motif or Composition	I
Natural Element	Artistic Motif or Composition	I
Expressional Quality	Artistic Motif or Composition	I
Character	Image	II
Event	Image	II
Named Object	Image	II
Place	Image	II
Personification	Image	II
Symbol	Image	II
Invenzione	A series of images	II
Social Object	Intrinsic Meaning	III
Cultural Phenomenon	Intrinsic Meaning	III

Symbols. In an artistic interpretation, an interpreter might recognize a symbol of a specific cultural context in an artwork. For the modeling of symbols, we reuse the entire Simulation Ontology (Sartini et al., 2021). This ontology, designed to conceptualize cultural symbols, uses the n-ary `sim:Simulation` class to link together a symbol, expressed by the class `sim:Simulacrum`, its symbolic meaning, expressed by the `sim:RealityCounterpart` class, the cultural context in which the symbol denotes the symbolic meaning (`sim:Context`) and the source of the claim (`sim:Source`). We aligned our class `icon:Symbol` to the `sim:Simulation` class to allow the expression of symbolic meanings using the Simulation Ontology structure.

Expression of Style. The expression of style is an important characteristic related to *icon* studies (Requirement 10, Section 5.2). Knowing the history of styles is, according to Panofsky (1972), a fundamental requirement for the correct interpretation of level 1 objects. Furthermore, as is evident, among others, from Warburg's studies on *Pathosformeln* and *Nachleben der Antike*, forms of style are a subject of interest in iconology. Therefore, we reused CIDOC-CRM to model it according to the solution adopted by the linked.art project,[30] using the structure:

```
crm:E36_Visual_Item crm:P2_has_type <style_type>.
<style_type> crm:P2_has_type <aat:300015646>.
```

where the last object is the Getty AAT vocabulary term defining style. Although the property's domain is `crm:E1_Entity`, it is suggested to use it with `crm:E36_Visual_Item`, in compliance with linked.art directions. Even if we do not express `icon:VisualSubject` and `icon:Artwork` as direct subclasses of `crm:E36`, it is possible to reuse this pattern since ICON's classes are not disjoint with CIDOC's ones. Therefore, we reuse this existing solution to model requirement 10 of Section 5.2 In this way, both the artwork itself and every portion of the image identified at each level can have its own style specification declared. The same pattern can be adopted to specify the genre of the artwork, using the term for genre (`aat:300056462`) in place of the style one.

Citations, sources, evidences. As shown in Figure 5.2, the CiTO ontology is directly reused to represent the source (`cito:citesForInformation`) from which the Recognition is extracted, the evidence (`cito:citesAsEvidence`) on which it is based and the supporting (`cito:givesSupportTo`) between acts of recognition. This representation is fundamental to encourage a documented description of the recognition, its reference and support.

30 https://linked.art/model/object/aboutness/#style-classification