



D2.4

Refined digital cultural resource data & data structure

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This deliverable presents the CrossCult digital datasets of the four project pilots. It contains a description of the methods and data structures used to semantically model and ingest the digital resources of the pilots into the CrossCult Knowledge Base following the semantics of the CrossCult Upper-level ontology, a set of examples of semantic enrichment, information retrieval and association discovery among the pilots' resources and other related information in the CrossCult Knowledge Base, and a brief description of how the pilots' digital resources can be viewed and access through three different front-end applications.



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1. Introduction

This report presents the results of a collaborative effort of the project partners, which took place in months M2-M25 of the project. It focuses on the production of semantically modelled digital cultural resources and their ingestion into the CrossCult Knowledge Base (CCKB) following the adopted semantics of the ontology as discussed in deliverable D2.5. The deliverable builds on an earlier version delivered in M12 (D2.2). The earlier deliverable discussed data integration issues relating to sample data of the four pilots using the semantics of an early version of the CrossCult Upper-level ontology and presented an early specification of the data structure. This deliverable presents the most recent version of the integrated data model, which builds on the refined version of the CCKB as discussed in deliverable D2.5. This final version expands to the full scale of the available data of cultural heritage items content, narratives and reflective topics, including refinements and semantic enrichment of the data with links to definitions of standard semantic web resources.

The deliverable is organised as follows. Section 2 discusses the data modelling methodology, highlighting the iterative process of converting the pilot data to ontology instances, and discussing the data modelling processes introduced in the project after M12. Section 3 discusses in detail the refined method of data ingestion and semantic enrichment, which explored further the full set of available semantics including the elements of the Upper-level ontology, the vocabulary of the CrossCult Classification Scheme (CCCS), the arrangement of the Venue ontology, and the linking to standard semantic web definitions. Section 4 presents several examples of information retrieval and association discovery between cultural heritage items and related information, which demonstrate the advantages and benefits of using the CCKB. Section 5 discusses three separate front-end applications supporting the CCKB, each one dedicated on providing a specific view and access to the content and structural elements of the knowledge base. Conclusions and a brief summary of the deliverable are discussed in Section 6.

A set of OWL files containing the data resources of the four pilots can be accessed at: <https://git.crosscult.lu/platform/ontologies/tree/master/Upper%20Level%20Ontology>.

2. Data Modelling Method

Data modelling in the context of this deliverable refers to the specific process of applying the conceptual arrangements and definitions of the CrossCult Upper-level ontology to a range of disparate data resources. The proposed CCKB, as discussed and presented in deliverable D2.5, is a CIDOC-CRM [1] compliant ontological structure supplemented by ontological definitions from SKOS [2], and extended with the project specific class Reflective Topic. It is a flexible and robust schema of standardised conceptual abstractions, capable of supporting the data modelling needs of cultural heritage data, which enjoy different degrees of complexity. The capability of the CCKB to support a range of complex and cross-searching scenarios is demonstrated in section 4.

The data modelling exercise relies on a rigorous set of Upper-level ontology definitions allowing to express a diverse range of cultural heritage data on the same level of semantics and with the same degree of granularity. It is a process of iterative data modelling, which runs throughout the life cycle of the CrossCult project with each modelling cycle refining and incrementing the volume of data that contribute to the project. Two iterations were conducted, from months 1 to 12 and from months 13 to 25, respectively, with both data modelling cycles going through three main stages; i) the stage of selecting the source data for each pilot, ii) the stage of data cleansing and intermediate transformation iii) the stage of data mapping and semantic enrichment. Figure 1 illustrates the processes involved during the above stages for the definition of data compliant with the semantics of the CCKB, from unstructured forms to the final OWL output.

The origin of the data as well their coverage and granularity varied significantly. Four distinct pilots contribute data to the CrossCult project covering a unique range of cultural heritage venues across Europe (see D2.1). From the large venue of National Gallery in London to the considerably smaller venue of the Archaeological Museum in Tripolis (Greece) and from the archaeological site of thermal springs in Montegrotto (Italy) to the historical points of interest in the cities of Luxembourg and Malta. The project ingests a wide range of diverse data associated to cultural heritage objects, events and subjects that span from Antiquity to Modern times. Such disparate data means there is a wide array of formats, technologies, management and classification approaches relevant to each data provider or source. Hence, the data modelling method caters for solutions that address issues relating to the diversity of content types, data formats, and levels of data detail. The following paragraphs discuss the various stages of the method and reveal the design techniques and development choices as these were developed during the data modelling iterations.

During the iterations of the data modelling task, three main dataset types were provided by the pilots (see Figure 1) with varying structures: from the unstructured or semi-structured to a structured data model. Structured and semi-structured formats were in most cases used to describe physical objects such as museum exhibits and archaeological monuments in terms of their unique inventory number, associated descriptions and relevant keywords. Reflective narratives and their associations with physical objects were described in less structured formats. During the first iteration, a sample of data of physical objects was ingested in the CCKB originating across the four pilots as discussed in the project deliverable D2.2. The second iteration focused on ingesting data of full coverage of physical objects and reflective topics and

narratives. Primarily, the second iteration focused on data from Pilots 2 and 3, which have already developed reflective topics and narratives associated with particular physical objects. Further ingestion of data is expected to be carried out by WP5 as reflective topics and narratives develop in the other pilots.

2.1. Data Modelling: First Iteration

The first iteration of data modelling, as discussed in deliverable D2.2, addressed a manageable and well balanced set of representative data, which did not vary significantly across the four pilots. Each pilot contributed data for 20 to 30 unique items (i.e. exhibits, painting, monuments, points of interest, etc.). Overall, the first iteration of the data modelling exercise delivered 80 uniquely identified items, which were composed of 102 Physical Man Made Objects and 17 Physical Man Made Things, delivering overall 3440 ontology (OWL) statements of named individual declaration and property assertion.

The tasks of manual data extraction, semi-automatic database construction, and automatic (OWL) statement generation were performed during the first iteration of the data modelling process (see D2.2). The manual data extraction process was designed to impose a data structure across a range of unstructured sample data available in text format. It focused on identifying entities of interest that would support the information retrieval needs of the pilot scenarios. The extracted pieces of information were stored as atomic values in intermediate formats, which were then utilised by the subsequent semi-automatic database construction stage. The aim of the semi-automatic database construction was to populate a database with a set of structured data as a series of relational database tables. This stage received spreadsheets directly from the pilots and from the manual data extraction stage. The database acted as a mediating layer between the semi-structured data files and the final OWL output feeding the routines of the Automatic Statements Generation stage with structured data. The bespoke PHP routines were executed in a web server environment to generate several hundred statements that implemented the mappings. The routines cater for the automatic generation of OWL statements with respect to individual(s) declaration, class assertion, object property assertion, and data property assertion.

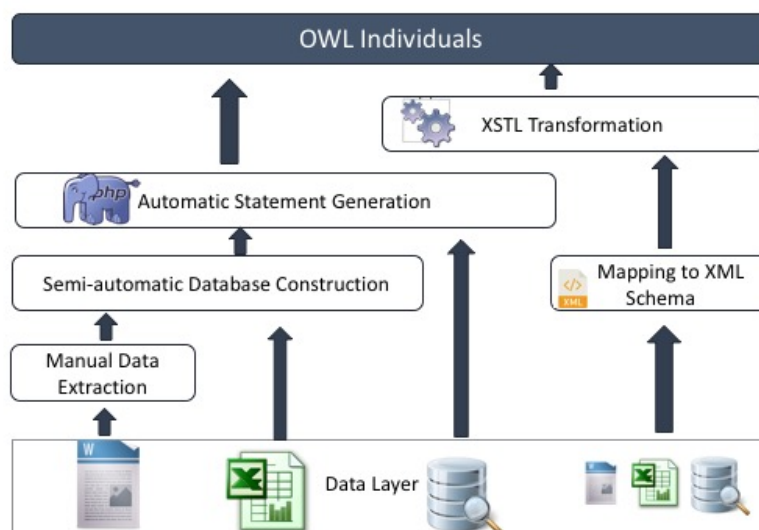


Figure 1: Data Modelling Stages from unstructured data input to the final OWL output

2.2. Data Modelling: Second Iteration

The second iteration of the data modelling stage supported a homogenised automatic processing approach of data ingestion based on standard data schema definitions as discussed in section 3. It was focused on data ingestion of reflective topics, narratives, digital resources and semantic enrichment definitions. A volume of data relating to 81 Physical Things (i.e. cultural heritage items), were fully instantiated in the knowledge base, leading to 176 instances of Reflective Topics and associated narratives. The narratives received 2140 semantic enrichments to 491 unique DBpedia concepts as discussed in section 3.4.1. In addition, 1250 unique vocabulary concepts of the CrossCult Classification Scheme (see D2.5) were ingested in the knowledge base, carrying mapping definitions to 663 Getty AAT [3], 73 Eurovoc [4], 78 LOC [5], and 114 Unesco Vocabulary [6] concepts. A total of 60305 Special Day events were also instantiated in the knowledge base, receiving 136624 enrichments to 35753 unique DBpedia concepts. Overall, the final version of the unified CCKB contains in total 1,201,533 axioms and 282,010 ontology individuals including cultural heritage items, vocabulary entries and DBpedia enrichments.

During the second iteration, the data modelling and ingestion method was refined to support a more complete and homogenised automatic processing approach, based on standard data schemas definitions instead of the bespoke PHP routines that were employed during the first iteration. The refined process, as illustrated in Figure 1, is based on XML formatting and XSLT processing for generating OWL statements of the ingested data. It provided an alternative method, which complemented the previous data modelling approach by enabling a uniform way of processing the range of pilot data including cultural heritage items, reflective topics, narratives, digital resources and semantic enrichment links. It improved the previous method by standardising the data schema and separating the processing stage from the data structure making easier to ingest the range of disparate dataset available in the project. The refined data modelling and ingestion method is fully discussed in Section 3.

3. Data Ingestion into CCKB

Data ingestion is described as the process of obtaining and importing data for immediate use or storage in a database. In the case of CrossCult, the role of the database is undertaken by the knowledge base of the project, hereafter the CCKB. The semantics of the CCKB and its structure is fully discussed and explained in the deliverable D2.5. The aim of the data ingestion task was to import into the knowledge base the range of available data by taking full advantage of the semantics available by the CCKB. The task built on the experience and methods of the earlier data modelling task (see Section 2.1) and it explored further the full set of available semantics including the elements of the Upper-level ontology, the vocabulary of the CrossCult Classification Scheme (CCCS) and the arrangement of the Venue ontology. The ingestion covered data relating to cultural heritage items, i.e. museum exhibits, monuments, etc. and data relating to the reflective topics and narratives aimed at fostering the reflection and re-interpretation requirements of the project. In addition, the data ingestion phase included the task of semantic enrichment of data with links to DBpedia, and the ingestion of a large set of descriptions of historical events to support calendar-based association discovery as discussed in Section 4.3.

For the purposes of a homogenised and automatic process of data ingestion, two separate XML schemas were designed. The schemas supported the development of XML files that were used as an intermediate data format for mediating the transition of the original, in many cases semi-structured, data formats to the final OWL format. Due to the disparate nature of the original data, the definition of consistent schemas was necessary for normalising any inconsistencies. The two schemas, namely the *physical objects* (section 3.2) and the *reflective topics schema* (section 3.3) define the hierarchy and data types of XML structures carrying data of cultural heritage items and reflective narratives, respectively.

The automatic process of data ingestion utilised XSLT transformation templates for wrangling the data from the intermediate XML format to the final OWL format. The transformation templates parsed the XML files and produced an output of OWL statements which were then appended to a unified OWL file containing the semantic definitions of the CCKB and data instances. The resulting OWL statements consisted of class assertions, property assertions and named individual declarations. The final version of the unified OWL structure contained in total 1,201,533 axioms and 282,010 ontology individuals including cultural heritage items, vocabulary entries and dbpedia enrichments. The full instantiated final version of the CCKB is made available by this deliverable under the filename *Crosscult-ontology-full-final.owl*. A lightweight version of the CCKB, which includes only the semantic definitions of the ontological structure and the CCCS vocabulary instances, is made available by the deliverable D2.5.

3.1. URI Scheme of the CCKB

Uniform Resource Identifier (URI) is an integral part of the definition of semantic web resources. Having a clear and meaningful URI scheme that adequately describes the ontology resources enables growth and evolution without conflicts and ambiguities. Human readable URI patterns that are easy to follow and understand can make more predictable the type of resource to which a URI has been assigned. The scheme is paying attention to the design principles of

simplicity, stability and manageability as these are specified by W3C [7]. The following project specific requirements are addressed by the proposed CrossCult URI schema.

- Avoid multiple URI definitions of the same CIDOC-CRM class when used by a separate constitutional ontology (i.e. Upper-level, Venue, and User ontology).
- Maintain a clear separation of ontology individuals between different content-providers. Thus, allowing the providers to keep their data under distinct definitions, which can be easily retrieved.
- Cater for flexible definition of groups of user ontology individuals. Thus, being able to group users (and their data) under nation-wide, city-wide, or single venue groups.

Taking the aforementioned requirements into account the following URI scheme is proposed.

- The project adopts the CIDOC-CRM Erlangen namespace (<http://erlangen-crm.org/160714/>) as the basis of URI definition of the CIDOC-CRM classes and properties.
- The CCKB base URI is defined as <http://kb.crosscult.eu>
- URIs of CCKB ontology individuals follow the pattern:
<http://kb.crosscult.eu/{cidoc-crm}/{individual}>
- URIs of CCCS (CrossCult Classification Scheme) concepts follow the pattern:
<http://kb.crosscult.eu/skos:Concept/{conceptID}>
- URIs of content provider specific ontology individuals follow the pattern:
<http://collection.{providerDomain}/{cidoc-crm}/{individual}>
- URIs of venue specific ontology individuals follow the pattern:
<http://venue.{providerDomain}/{cidoc-crm}/{individual}>
- URIs of user specific ontology individuals follow the pattern:
<http://{group}.{providerDomain}/{classname}/{named individual}>

In the above, “group” refers to an “authentication realm”; authentication realms unify access to a number of applications, services or resources, typically hosted, managed or supervised by a particular organisation.

3.2. Physical Object XML Schema

The Physical Object XML Schema sets the hierarchical composition and data type elements of the XML files, which contain data of cultural heritage items such as, museum exhibits, archaeological monuments, gallery paintings, etc. It is a two levels deep hierarchical tree having overall 18 separate elements of various dimensions and parameters describing a physical object as illustrated in **Error! Reference source not found.** Several elements of the schema receive values of URI datatype, which is necessary for the definition of persistent identifiers (pid), which are required in the definition of ontological instances capable of being retrieved and inferred by the semantics of the CCKB. The hierarchical tree contains the following elements:

- **originalID**: it carries the inventory identifier of an object as it is originally assigned by the collection or institution it belongs to. It is maintained in the structure for maximum interoperability.

- **title:** the title of the object as it is assigned by the collection or institution it belongs to.
- **type:** it contains a single entry from the CCCS vocabulary that describes the object, as for example, painting, sculpture, figurine etc.
- **dimension:** it carries the size of the object. It contains the child elements, **height** and **width**, which take numerical values (integer) in terms of centimetres.
- **date:** it receives values of temporal expressions, which can be time spans, e.g. 104 - 110 AD, periods, e.g. early 15th century, or any other combination conveying temporal information. Every entry of the date element has a textual description held by the **label** attribute whilst the element contains two child elements, **begin** and **end**, which receive the actual Date datatype values of the element.
- **period:** a complementary element to the date element, containing a single entry from the CCCS vocabulary relating to the period mentioned by the date element.
- **location:** it contains a reference to the actual physical location of the object as it is instantiated by the venue ontology. The brief description of the location e.g. “Room 1” is accommodated by the **label** attribute, whereas the child element **fallswithin** holds a reference to the spatial instance of the venue ontology in which the location falls within, for example “Room 1” falls with “Archaeological Museum of Tripolis, Greece”.
- **description:** it contains a textual description of the object, usually a couple of sentences long.
- **image:** it holds a reference to the ontology instance of an image of the object and contains two child elements: the **type** element that defines the image as default, thumbnail, and secondary, and the **source** element that carries the URL of the original source of the image.
- **keyword:** more than one keywords entries from the CCCS vocabulary can be assigned to an object. Keywords describe an object in terms of relevant subject and topics.
- **material:** one or more material types can be assigned to an object, which are made available by the CCCS vocabulary.

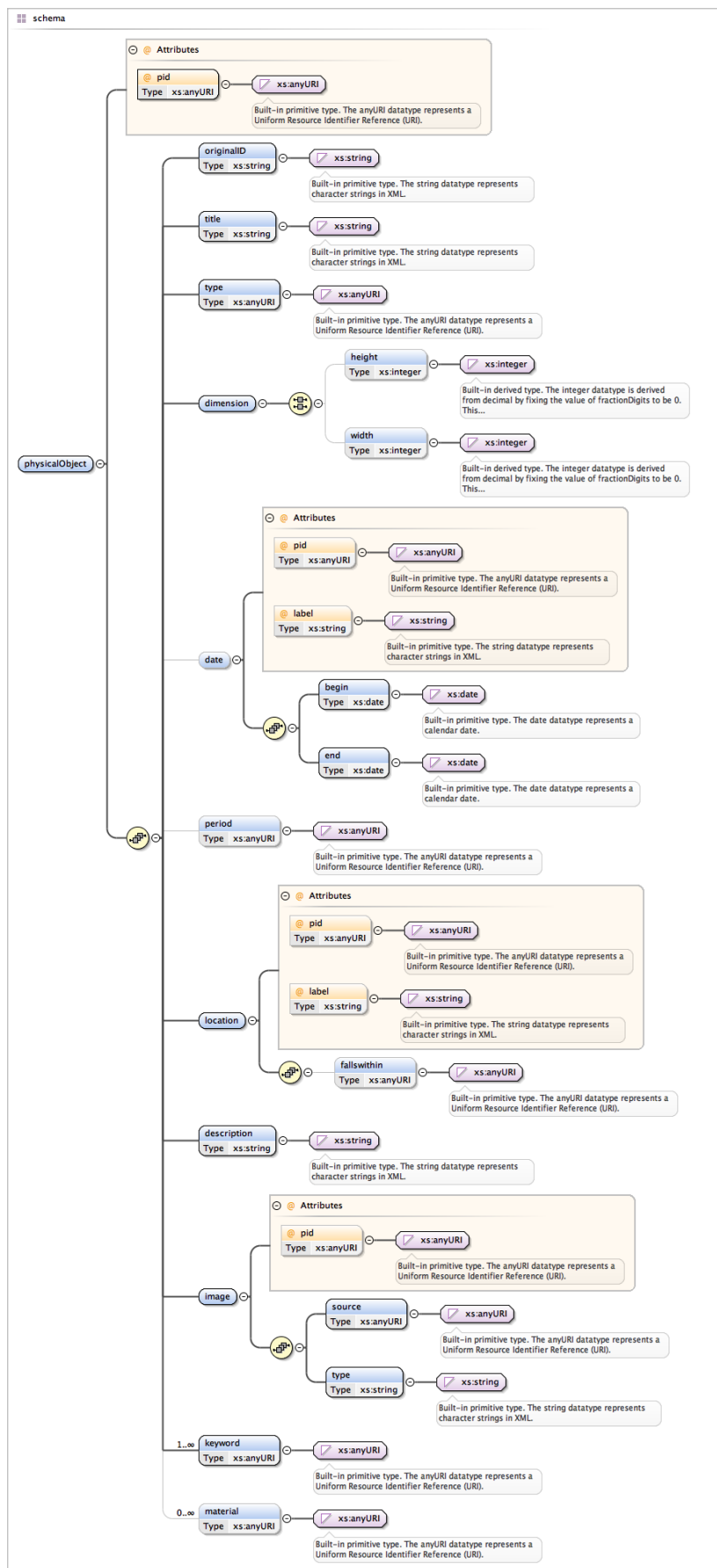


Figure 2: Cultural Item (Physical Object) XML Schema

3.3. Reflective Topics XML Schema

The Reflective Topics XML Schema sets the hierarchical composition and data type elements of the XML files that contain data of reflective topics and related elements such as, reflective narratives and digital resources. Similarly to the Physical Objects XML schema, the schema consists of a two-level deep hierarchical tree and incorporates URI datatype values for referencing individuals of the CCKB, as shown in **Error! Reference source not found.** Overall, 9 separate elements constitute the first level of the hierarchy with many of the elements containing child elements. The tree contains the following elements:

- **composedOf:** it contains references to other reflective topics, which can be used for composing complex reflective topics. For example, the Reflective Topic "Migration and Industrial Revolution in Europe" can be composed by the Reflective Topics "Migration in Luxemburg", "Industrial Revolution in France during the early 19th century", "Labour migration in the UK", etc.
- **first:** it supports the sequential arrangement of complex reflective topics by holding a reference to the first reflective topic of the composition.
- **next:** it supports the sequential arrangement of complex reflective topics by holding a reference to the next reflective topic of the composition.
- **last:** it supports the sequential arrangement of complex reflective topics by holding a reference to the last reflective topic of the composition.
- **title:** the title of the reflective topic usually assigned by a curator or a humanities expert.
- **isReflectedby:** it holds a reference to the physical object supporting a reflective topic. For example, the Eiffel tower, can be used to drive a reflection about engineering and industrial revolution, hence, the Physical Object "Eiffel tower" -reflects- the Reflective Topic "Engineering Marvels of Europe".
- **digitalItem:** a reflective topic can refer or make use of several digital media resources which can be images, videos, web pages, audio files, etc. For this reason, the element contains two child elements, **type** and **source**, for holding the respective type of digital resource and a reference to the original resource, respectively.
- **narrative:** narratives are short stories authored by historians and social scientists, aimed at contextualising a reflection topic with inspiring viewpoints and facts. Usually they have a textual form, which is accommodated by the child element **note**. An audio form of the narrative is carried by the child element **mediaSource**, which holds a URI reference to a media resource. The child element **dbpediaResource** holds a link to a DBpedia concept that relates to the narrative. A narrative may relate to many DBpedia concepts.
- **keyword:** more than one keywords entries from the CCCS vocabulary can be assigned to a reflective topic. Keywords describe a reflective topic in terms of relevant subject and topics and act complementary to the links of narratives to DBpedia concepts.

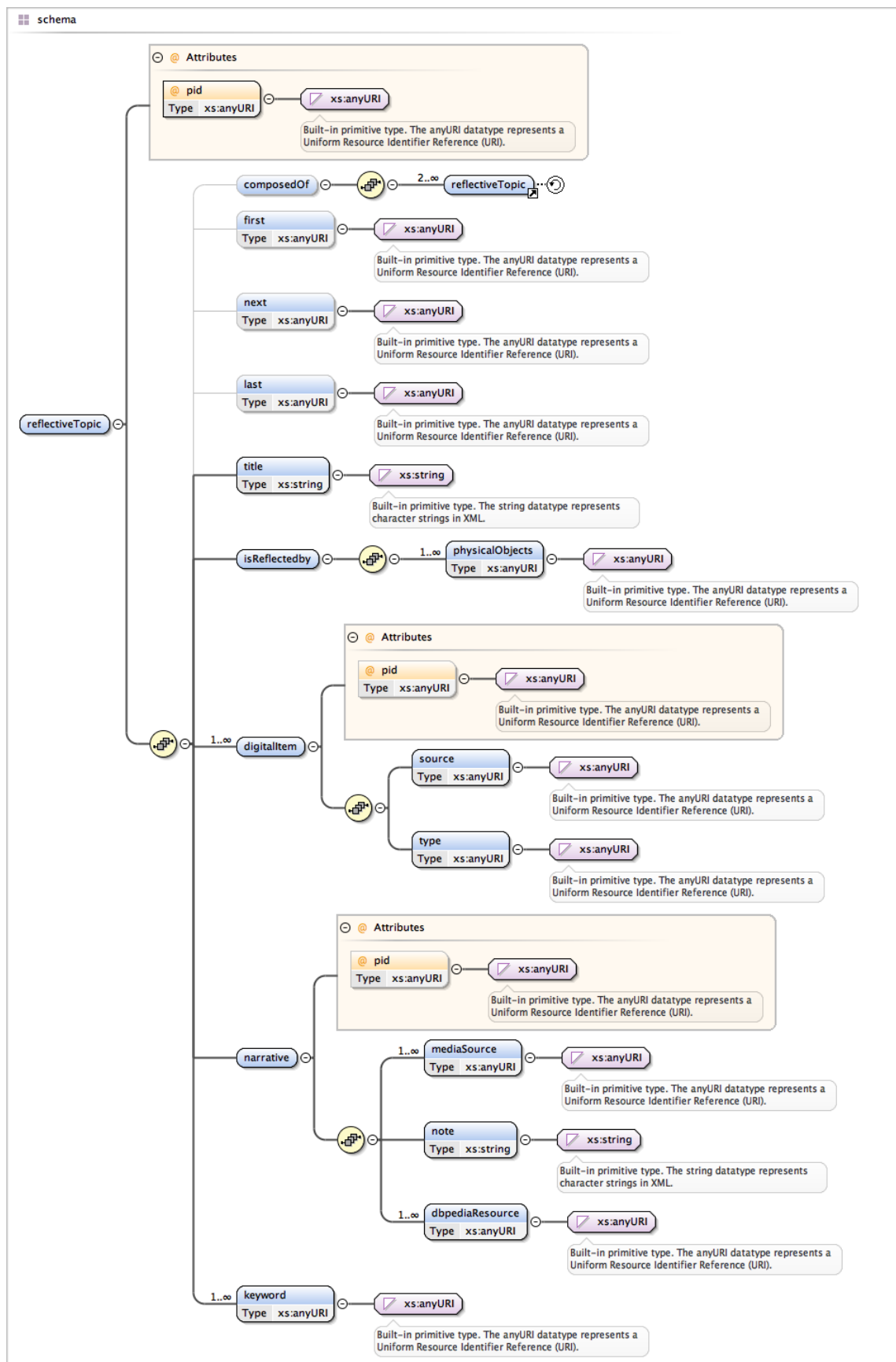


Figure 3: Reflective Topic XML Schema

3.4. Semantic Enrichment

The data modelling and ingestion phase enriched previously unstructured or semi-structured data with the conceptual arrangements and definitions (i.e. the semantics) of the CrossCult ontology. An additional semantic enrichment phase applied definitions from DBpedia, a standard semantic web resource, to a selected set of CrossCult ontology individuals, improving the utility and interoperability characteristics of the pilots' data.

3.4.1. Semantic Enrichment of Reflective Narratives

The process of semantically enriching data with links to external semantic web resources focused on reflective narratives, which are short stories evolving around a particular museum item or a broader collection of exhibits, aiding reflection and re-interpretation by storytelling. Stories, images, hypertext resources and audio-visual elements are interweaved into rich compositions, fostering reflection within the semantic environment of the CCKB. As a result, applications that use the CCKB can provide a synthesised view on a topic that can hardly be conveyed by the usual item description that accompanies a museum exhibit.

In order to increase the interoperable properties of the narratives, their content has been automatically processed, and narratives have been enriched with an additional layer of subject heading semantics. The process of automatic semantic enrichment of narratives complements a previous author-based assignment of CCCS concepts to physical items and reflective topics. The enrichment was achieved by a Named Entity Recognition and Resolution task which was carried out using the DBpedia Spotlight tool [8]. The tool automatically recognises mentions of DBpedia resources in natural language text, following a match and disambiguate process, which links unstructured information sources to the Linked Open Data cloud. It is an open source platform deployed as a web service freely available for public use.

The Reflective Narrative (i.e. E73 Information Object cckb:E73/rn_0053), as illustrated in Figure 4 **Error! Reference source not found.**, was enriched with links to a number of DBpedia resources, such as dbpedia:Kithara, dbpedia:Sappho, dbpedia:Muse, and dbpedia:Appollo. The automatic assignment of such resources as keywords to reflective narratives complements the authored-based assignment of subject headings, albeit some crossover is to be expected. For example, the authored-based process assigned to the Reflective Topic (cckb:Reflective_Topic/rt_0053) the terms Muses, Apollo and Education, whereas Apollo, Lyre and Marble were assigned to the physical item cckb:E22/MT0034. The item is a marble pedimental plaque depicting an assembly of the nine Muses with Apollo Pythios in a rocky landscape. Hence, Apollo is assigned to all three ontology individuals (i.e. physical item, reflective topic, and reflective narrative) but the reflective topic and narrative instances enjoy a complementary assignment of terms such as Education, and Sappho. This multi-layered assignment of keywords to ontology individuals within a semantic network of related individuals enables a flexible retrieval and aggregation of resources, capable of supporting a multidimensional association, beneficial to information discovery and potentially to content personalisation.

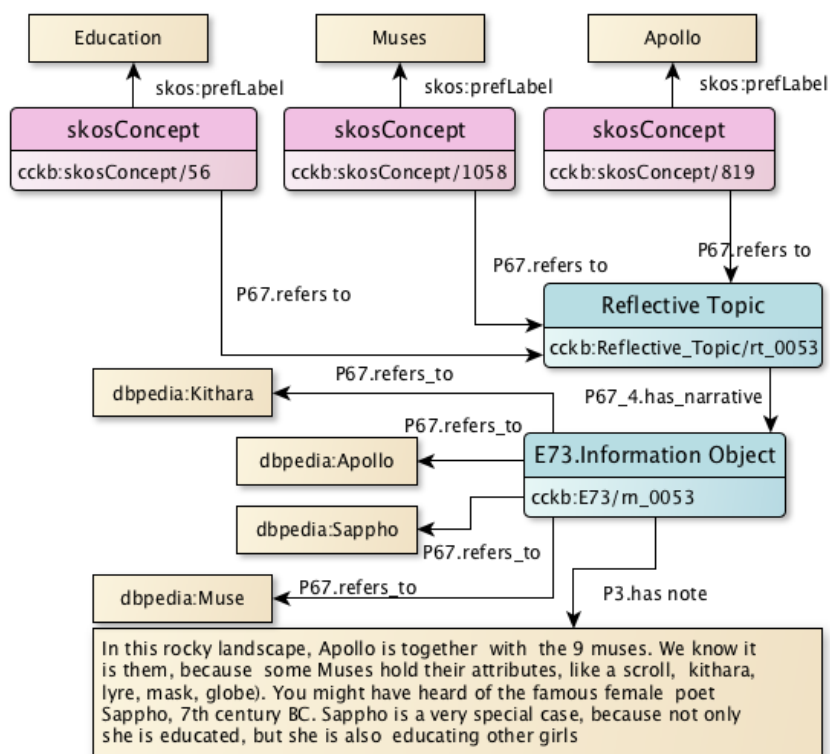


Figure 4: Semantic Enrichment Example of Reflective Narrative

3.4.2. Semantic Enrichment of Calendar-base Events

The CCKB has ingested two separate resources listing special dates; the online resource on-this-day [9], which contains historical events co-occurring on the same date, and a manually compiled list of annually celebrated commemorative dates. The role of such “special” dates in the CCKB is to trigger and facilitate a calendar-based association across cultural items, and to act as entry points for delivering personalised content to the users. In total, 60,525 historical events and dates were ingested in the knowledge base, with 233 separate entries originating from the commemorative date list and the rest coming from the on-this-day resource. The vast number of entries coming from the on-this-day resource is explained by its extended coverage which includes historical events from the 4000 BC until today.

The volume of the historical events has been automatically enriched with links to DBpedia resources, following the same method of Named Entity Recognition and Resolution, as discussed above, which utilised DBpedia Spotlight. Each historical date is accompanied by a brief but condensed description, no more of a couple sentences long. Such descriptions have been used as the input to DBpedia Spotlight for creating links to DBpedia resources. Moreover, the 233 commemorative dates were automatically enriched with links to DBpedia resources, using their titles as input, and with links to concepts of the Getty Art and Architecture Thesaurus, following a manual, author-based process.

The special day entries carry descriptions about developments that occur annually or have occurred in the past on particular dates, which in some form or another affect or have affected some states or behaviours. In this respect, they can be formally understood as events that can fall under the definition of the CIDOC-CRM class *E5.Event*, which “comprises changes of states in

cultural, social or physical systems, regardless of scale, brought about by a series or group of coherent physical, cultural, technological or legal phenomena”. **Error! Reference source not found.** illustrates the semantics, classes and properties, that are employed for formally expressing the instances of special days. At the core of the definition is the *E5.Event* which holds together the various elements of a special day instance. The *E52.Time-Span* class defines the actual date of the event, which is expressed as an instant of time in form of `xsd:dateTime`¹ datatype. The *E50.Date* class compliments the temporal definition of a special day instance by providing a date in form of an appellation. The actual description of a special day is accommodated by an *E73.Information Object* which also carries (*P67 refers to*) the links to the DBpedia concepts. **Error! Reference source not found.** illustrates the example of the special day `cckb:E5/04d1e42250`, which occurred on 21 April 1818, is about Franz Grillparzer's ‘Sappho’ premiere in Vienna, and is enriched with links to the DBpedia concepts “Vienna”, “Sappho” and “Franz Grillparzer”.

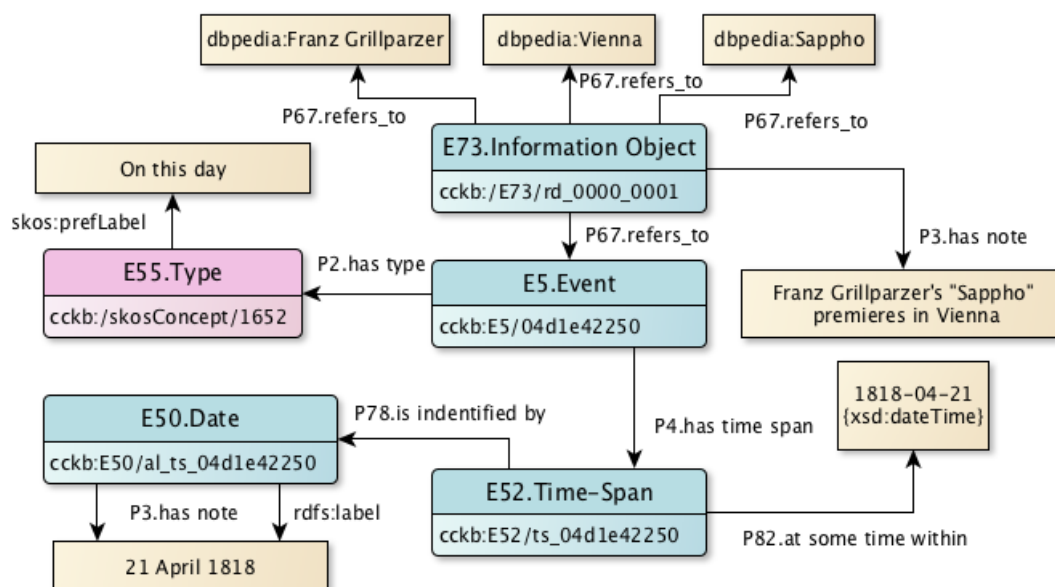


Figure 5: The Semantics of Special Day Events

¹ <https://www.w3.org/TR/xmlschema11-2/#dateTime>

4. Information Retrieval and Association Examples

This section discusses several examples of information retrieval and association discovery between cultural heritage items and related information available from the CCKB. The examples demonstrate the advantages and benefits of using semantics for retrieving information and revealing connections, which can leverage serendipity, stimulate curiosity and foster reflection on heritage items and historical topics. The examples unfold three information seeking and association discovery scenarios, which are supported and explained by relevant diagrams, SPARQL queries and screenshots. The first scenario is about discovering museum exhibits co-located in the same room and sharing a common reflective topic, i.e. they can be related under a common topic or story. The second scenario expands from the first one for discovering cultural heritage items that share a common reflective topic but belong to different museums, hence, revealing connections across CrossCult pilots. The third scenario is about discovering associations between cultural heritage items and special events or commemorative days resulting from the semantic enrichment of narratives with DBpedia concepts.

4.1. Co-located Museum Exhibits - Scenario

The following scenario is about retrieving information and related narratives of museum items co-located in the same room and connected through a common subject or topic of interest. For example, a user walks into Room 9 of the Archaeological Museum of Tripolis and wishes to find objects in the room relating to a common reflective topic. In total, 15 separate reflective topics relate to the room, associated with concepts such as, Life events, Hair styles, Public education, Deities, Social class, Worship, Immortality, etc. The user makes the choice to retrieve items and narratives relating to the topic of Worship. The SPARQL query (Appendix 1) implements this choice by selecting museum items (E22_Man-Made_Object) located in Room 9 (loc_0000_0008) connected with a reflective topic that relates (P67i_is_referred_to_by) to the topic of Worship (skosConcept/990). The SPARQL query returns three museum items, MT0006, MT0017 and MT0018, as shown in Figure .

item	reflective_topic	
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-state
http://collection.tripolismuseum.gr/E22/MT0017	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-state
http://collection.tripolismuseum.gr/E22/MT0018	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-state

Total results: 3, displaying 1-3 50 per page
 Show datatypes Show languages
 Page 1 of 1

Figure 6: SPARQL query results for co-located museum exhibits in Room 9 (Archaeological Museum of Tripolis)

The three items, MT0006 (a figurine of a woman wearing a veil), MT0017 (bronze object – votive offering, probable earring) and MT0018 (bronze object – votive offering, bracelet), reflect the Reflective Topic rt_0000_0121, which is about Religion and Rituals. As shown in the diagram in Figure 7, all three items are located in the Room 9 and reflect the same reflective topic, which is referred by the SKOS concepts Deities, Worship, Worshipers, Religion, and Arcadia. The reflective topic has a narrative, which is about worship and community life of Arcadia in antiquity.

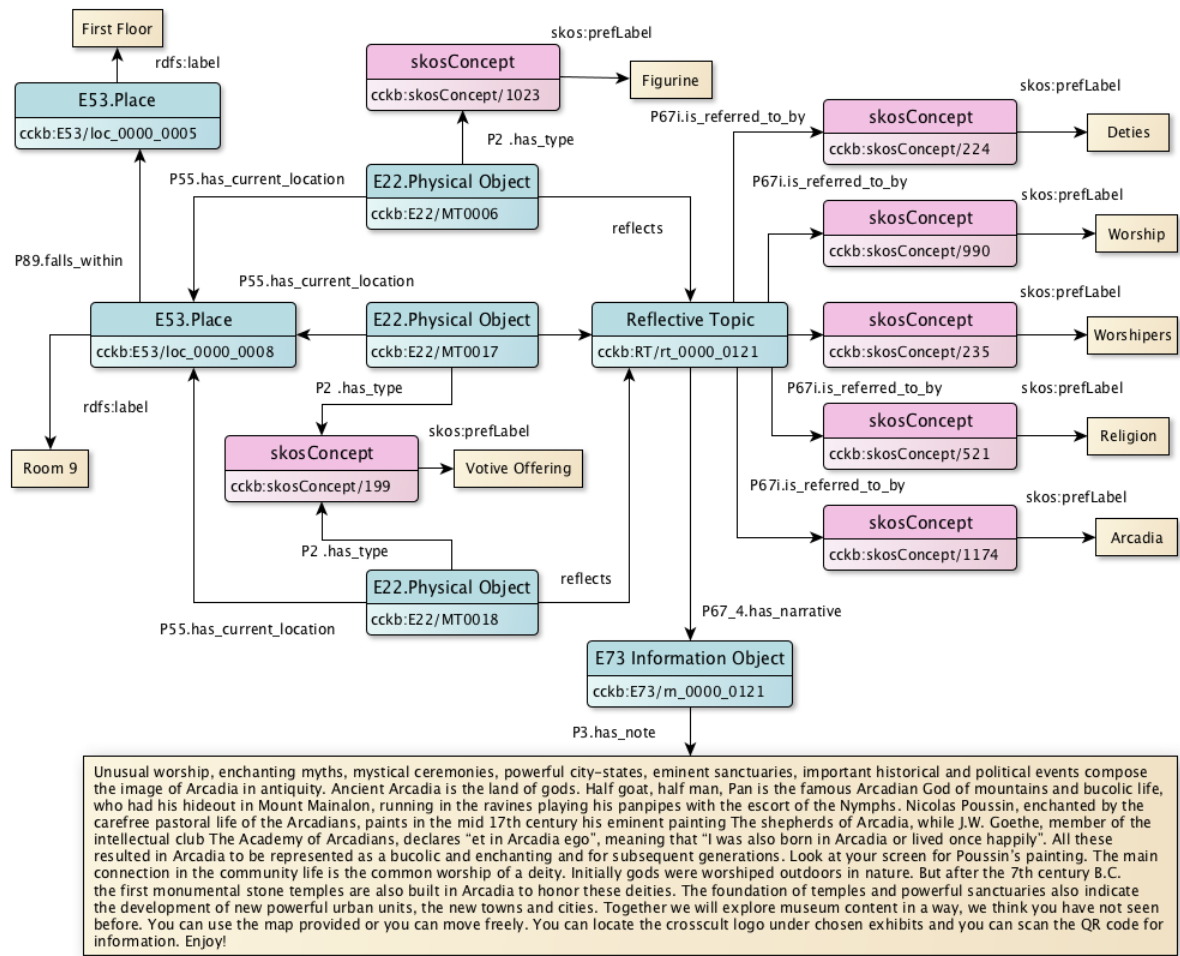


Figure 7: Semantic Relationships of co-located museum exhibits in Room 9 (Archaeological Museum of Tripolis)

Reflective Topics in the CCKB can be composed by other Reflective Topics, as for example books are composed by chapters, which in turn can be composed by sections. The aforementioned example presents the relation of three museum items to a reflective topic, which can be unfolded to a composition of reflective topics. The expanded SPARQL query (Appendix 2) retrieves seven additional triples of relations between the three museum items and five new reflective topics as shown in Figure 8.

item	RT	
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0142	Some of the most famous items in this museum are these clay figurines from Gortsouli hill in Mantinea
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0143	As we know Artemis is closely related to girls before they are married and it is possible that these
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0144	The ancient Greek religion was an important part of the people public and private lives. They strongly
http://collection.tripolismuseum.gr/E22/MT0017	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0136	In this cabinet you can see many different bronze objects. Most of them are votives, offerings to div
http://collection.tripolismuseum.gr/E22/MT0018	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0136	In this cabinet you can see many different bronze objects. Most of them are votives, offerings to div
http://collection.tripolismuseum.gr/E22/MT0017	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0137	Tegea was a very important Arcadian city, known for the temple of Ales Athena. The architectural desi
http://collection.tripolismuseum.gr/E22/MT0018	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0137	Tegea was a very important Arcadian city, known for the temple of Ales Athena. The architectural desi

Total results: 7, displaying 1-7 / 50 per page
 Show datatypes Show languages
 Page 1 of 1

Figure 8: Results of the expanded SPARQL query for co-located museum exhibits in Room 9

The diagram in Figure 9 illustrates the results of the expanded SPARQL query. The reflective topic (rt_0000_0121) is composed by the reflective topics rt_0000_0136, rt_0000_0137, and

rt_0000_0146, which are reflected by the museum items MT0017, MT0018, and MT0006, respectively. Each reflective topic carries (has) a narrative, which presents a story of an object around a particular topic, in this case Worship. For example, the museum item MT0017, is a bronze object, possibly a personal jewellery, which has been offered as a votive and was found in Tegea. The museum item MT0018 is also a votive offering found in Tegea, which according to the respective narrative (rn_0000_0137) “was a very important Arcadian city, known for the temple of Alea Athena”. The item MT0006 is a clay figurine found in Mantineaia, the place of prehistoric Ptolis founded by “Mantineas, the mythical grandson of Pelasgos, the first parent of Arcadians”. This rich network of narratives and items fosters a rich user experience impossible to deliver without employing the CCKB semantics. The example clearly demonstrates the added value that can be brought by the knowledge base, where three simple museum items, which in other cases might have gone unnoticed, participate in an experience that enables users to find out more about worship and ritual in antiquity, particularly in the area of Arcadia.

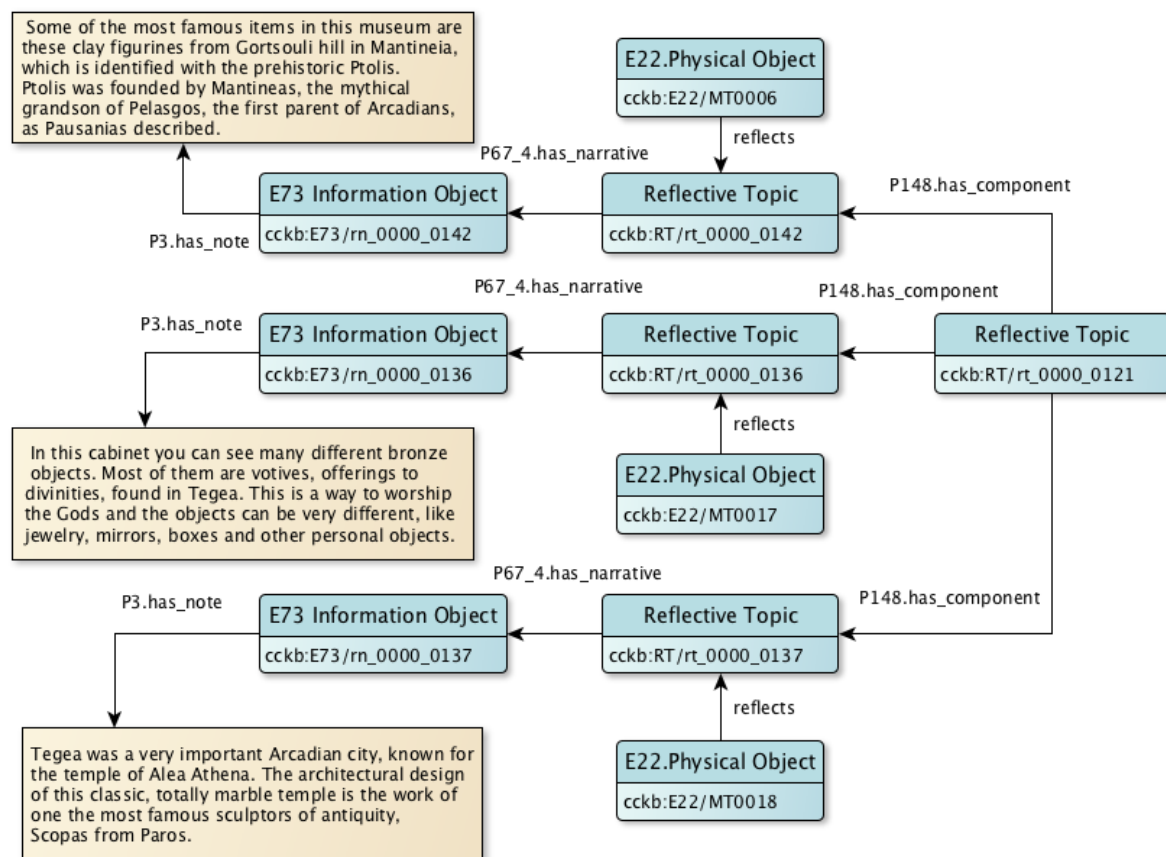


Figure 9: Semantic Relationships of a composite Reflective Topic for co-located museum exhibits

4.2. Connections across Museums - Scenario

The following scenario is about retrieving information and related narratives of museum items across museums connected through a common subject or topic of interest. This scenario extends the scenario of section 4.1 by retrieving items located in different venues, which relate to common or similar reflective topics. For example, a visitor of the archaeological museum of Tripolis having experienced the narratives and items described in the scenario (section 4.1)

wishes to find out more items that reflect topics relating to worship which might be located in the same museum and elsewhere. The SPARQL query (Appendix 3) retrieves items known to the CCKB which reflect topics relating to worship. In particular, the query performs a semantic expansion over the concept of Worship by exploiting the broader term relationships available in the CCCS. Hence, the query retrieves items reflecting topics of Religious Activities and narrower concepts, such as Worship and Rituals, as shown in Figure 10.

item	reflective_topic	
http://collection.pilot2.eu/E22/EP0003	http://collection.pilot2.eu/reflective_Topic/rt_0000_0086	After a few hours' journey and having left the main road, Apellas's group finally reached
http://collection.pilot2.eu/E22/EP0004	http://collection.pilot2.eu/reflective_Topic/rt_0000_0086	After a few hours' journey and having left the main road, Apellas's group finally reached
http://collection.pilot2.eu/E22/EP0005	http://collection.pilot2.eu/reflective_Topic/rt_0000_0086	After a few hours' journey and having left the main road, Apellas's group finally reached
http://collection.pilot2.eu/E22/EP0006	http://collection.pilot2.eu/reflective_Topic/rt_0000_0086	After a few hours' journey and having left the main road, Apellas's group finally reached
http://collection.pilot2.eu/E22/EP0007	http://collection.pilot2.eu/reflective_Topic/rt_0000_0086	After a few hours' journey and having left the main road, Apellas's group finally reached
http://collection.pilot2.eu/E22/EP0010	http://collection.pilot2.eu/reflective_Topic/rt_0000_0087	When night fell, the priest led Apellas through the shrine lit up by many little lanterns
http://collection.pilot2.eu/E22/EP0011	http://collection.pilot2.eu/reflective_Topic/rt_0000_0087	When night fell, the priest led Apellas through the shrine lit up by many little lanterns
http://collection.pilot2.eu/E22/EP0012	http://collection.pilot2.eu/reflective_Topic/rt_0000_0087	When night fell, the priest led Apellas through the shrine lit up by many little lanterns
http://collection.pilot2.eu/E22/EP0013	http://collection.pilot2.eu/reflective_Topic/rt_0000_0087	When night fell, the priest led Apellas through the shrine lit up by many little lanterns
http://collection.pilot2.eu/E22/EP0014	http://collection.pilot2.eu/reflective_Topic/rt_0000_0087	When night fell, the priest led Apellas through the shrine lit up by many little lanterns
http://collection.pilot2.eu/E22/EP0015	http://collection.pilot2.eu/reflective_Topic/rt_0000_0088	Apellas suddenly woke up at dawn, grateful for seeing the god and, like everyone in the p
http://collection.pilot2.eu/E22/EP0016	http://collection.pilot2.eu/reflective_Topic/rt_0000_0088	Apellas suddenly woke up at dawn, grateful for seeing the god and, like everyone in the p
http://collection.tripolismuseum.gr/E22/MT0004	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0074	This 2nd century AD marble tombstone, shows a family. In some tombstones, like this one, y
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0006	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0157	Some of the most famous items in this museum are these clay figurines from Gortsouli hill
http://collection.tripolismuseum.gr/E22/MT0007	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0008	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0009	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0010	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0017	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0018	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0019	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0020	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0028	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0041	Women had an important role in funerals in ancient Greece. In this room you can see funera
http://collection.tripolismuseum.gr/E22/MT0028	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0029	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san
http://collection.tripolismuseum.gr/E22/MT0034	http://collection.tripolismuseum.gr/reflective_Topic/rt_0000_0121	Unusual worship, enchanting myths, mystical ceremonies, powerful city-states, eminent san

Total results: 26, displaying 1-26 | 50 per page

Show datatypes Show languages

Page 1 of 1

Figure 10: Results of SPARQL query retrieving items reflecting topics of Religious Activities and narrower concepts

The diagram in Figure 11 illustrates the results of the SPARQL query regarding the connections across museums. The item MT0017, as discussed in section 4.1, is a votive offering reflecting the Reflective Topic (rt_0000_0121) which is about Religion and Rituals in Ancient Greece, and relates to the topic of Worship. By semantically expanding on the topic of Worship through its broader concept Religious Activities, the query retrieves the item EP0014, which is located in the Archaeological Museum of Asklepeion in Epidaurus. The item is a votive stele of M. Iulius Apellas, reflecting the Reflective Topic (rt_0000_0087) entitled “The night inside Abaton” and relating to the topic of Rituals. The associated narrative is about Apellas experiencing the healing ritual of spending a night in the Abaton, a dormitory for those awaiting Asklepios' advice on healing. The scenario demonstrates how meaningful and serendipitous connections between museum items of separate venues can be achieved through Reflective Topic associations. In this case, a votive offering located in the Archaeological Museum of Tripolis and a votive stele located in the Archaeological Museum of Asklepeion Epidaurus, can trigger reflections around the topics of ritual and worship in the relationships between religion and healing practices in antiquity.

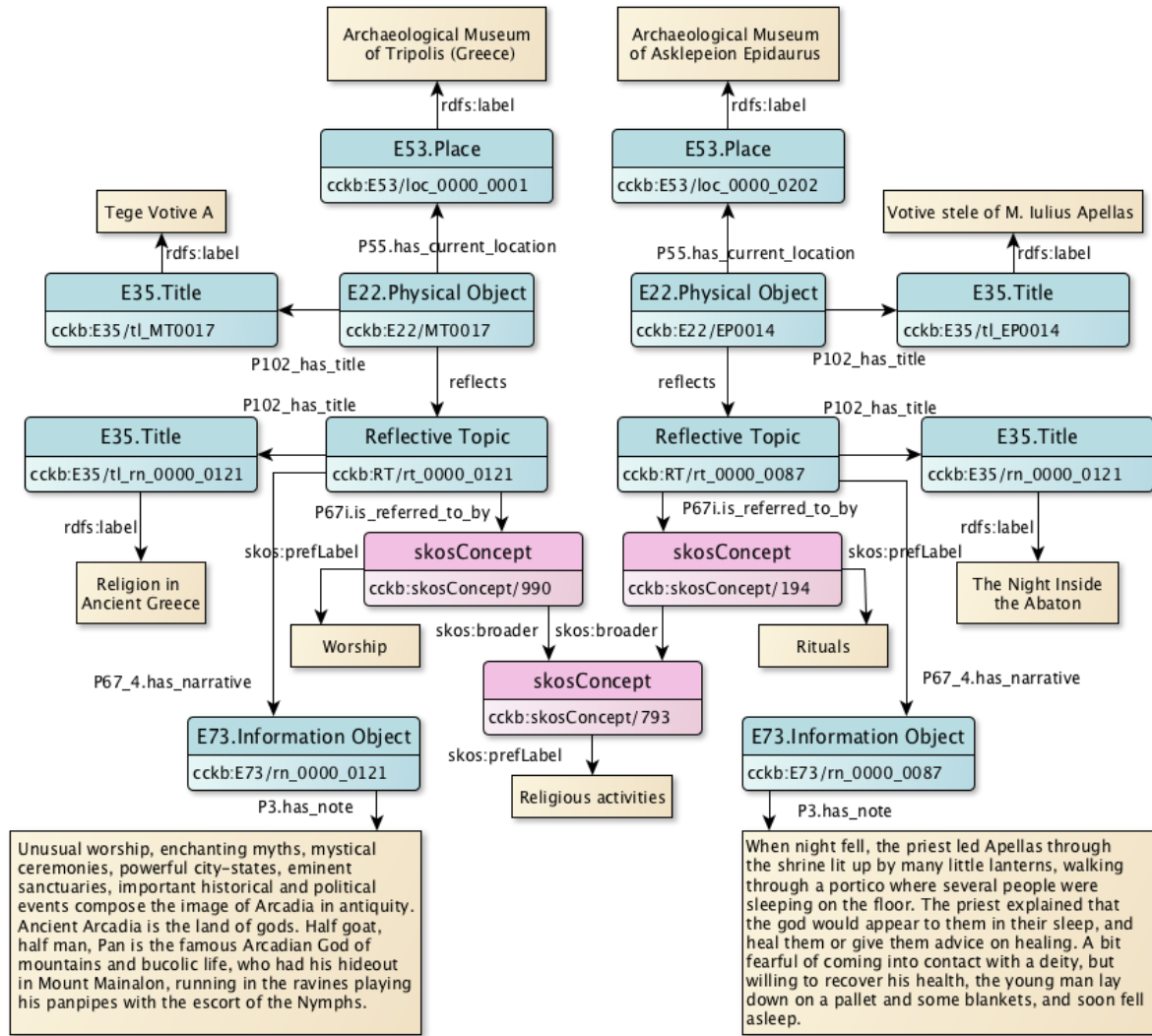


Figure 11: Connections across museums based on the concept of Religious activities

4.3. Calendar Based Association Discovery- Scenario

The following scenario explores semantic definitions in terms of class assertions and property relations, which associate museum exhibits with special days. The SPARQL query (Appendix 4) exploits DBpedia-based of the Special Days descriptions by connecting them to narratives of Reflective Topics, which are reflected by museum items.

Error! Reference source not found. illustrates a particular example of a discovered association between a museum item and a special day, based on a query that exploits the semantics of the CCKB and links of ontology instances to DBpedia concepts. In detail, the museum item MT0034, which belongs to the Archaeological Museum of Tripolis, is a marble plaque depicting an assembly of the nine Muses with Apollo Pythios in a rocky landscape”. The item is used to drive reflection on the topic of Education, hence, it is connected to (reflects) the reflective topic rt_0053, which in its turn is contextualised by the narrative rn_0053. The narrative tells the story of Apollo and Muses and how music played an important role in the education of Ancient Greeks particularly of women. It then moves into highlighting the role of the female poet Sappho, in music education of women in ancient Greece. The narrative is enriched with several

DBpedia concepts, one being the DBpedia:Sappho, which is also used by the special day 041de42250, the day Franz Grillparzer’s play ‘Sappho’ was premiered in Vienna, on 21 April 1818. Through this special-day entry, an ancient artefact, depicting Apollo and the Muses, can be related to an 19th century tragedy inspired by the life of ancient Greek female poet, with both ends supporting and stimulating a discussion about education of women, which has been originated by a reflective topic of the CCKB.

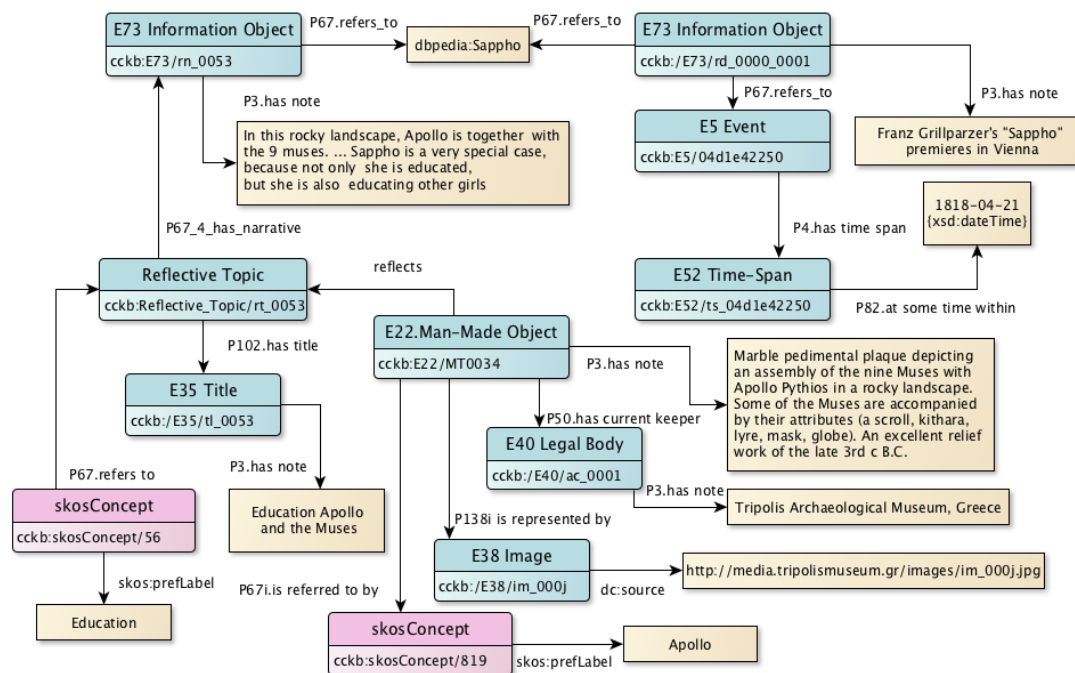


Figure 12: Discovery of an association between a museum item and a special day event

5. The CCKB Front-end sites

The CCKB can be accessed online via three separate front-end applications, each one dedicated to providing a specific kind of view and access to the content and structural elements of the knowledge base. In particular, the instantiated content (i.e. ontology individuals) and their relationships can be explored online through the WissKI portal, the content and thesauri type of relationships of the CrossCult Classification Scheme (CCCS) can be accessed online through the TemaTres portal, whereas the fully fleshed version of the CCKB can be enquired and managed online through a dedicated Blazegraph Workbench SPARQL end-point. The following sections briefly discuss the three front-end applications and present screenshots that highlight their core functionality.

5.1. CCKB WissKI

WissKI is an open source Virtual Research Environment and Content Management System for Cultural Heritage, which is web-based and implemented as a modular extension of the very popular open source content management system (CMS), Drupal [10]. It provides a Wikipedia-like fashion access to the data, combining textual, visual and structured information, while it enables detailed view of data as RDF triples. The CrossCult WissKI portal is available at <http://wisski.infra.crosscult.uop.gr/>. Figure 113 presents a screenshot of the portal of a page containing a list of cultural heritage objects. The list provides links to detailed views of the objects containing information about the title, description, type, etc. as illustrated in **Error! Reference source not found..**

The screenshot shows the CrossCult WissKI portal interface. At the top, there is a blue header with the CrossCult WissKI logo and navigation buttons: Home, Find, Navigate, and Create. Below the header, there is a search bar and a 'Tools' section with an 'Add content' link. The main content area is titled 'Cultural Heritage Objects' and displays a list of 48 items, showing the first 16. Each item is a blue hyperlink with a unique ID. The items are arranged in a grid format. At the bottom of the list, there is a pagination control showing '1 2 >> Last >>'.

Cultural Heritage Objects					
Item -MT0001	Item -MT0002	Item -MT0003	Item -MT0004	Item -MT0005	Item -MT0006
Item -MT0007	Item -MT0008	Item -MT0009	Item -MT0010	Item -MT0011	Item -MT0012
Item -MT0013	Item -MT0014	Item -MT0015	Item -MT0016	Item -MT0017	Item -MT0018
Item -MT0019	Item -MT0020	Item -MT0021	Item -MT0022	Item -MT0023	Item -MT0024
Item -MT0025	Item -MT0026	Item -MT0027	Item -MT0028	Item -MT0029	Item -MT0030
Item -MT0031	Item -MT0032	Item -MT0033	Item -MT0034	Item -MT0035	Item -EP0002
Item -EP0003	Item -EP0004	Item -EP0005	Item -EP0006	Item -EP0007	Item -EP0010
Item -EP0011	Item -EP0012	Item -EP0013	Item -EP0014	Item -EP0015	Item -EP0016

Figure 113: List of Cultural Heritage Items available from the WissKI portal

Home - Navigate - Cultural Heritage Objects

Search

Tools

[Add content](#)

Item -MT0010

View Edit Delete Triples Graph Merge

Collection ID
<http://collection.tripolismuseum.gr/E42/5767>

Title
 Cybele

Keeper
 The Museum of Tripolis
 The Museum of Tripolis

Image
http://collection.tripolismuseum.gr/E38/im_0000_5767

Type
<http://kb.crosscult.eu/skosConcept/1299>

Reflects
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0023
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0038
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0068
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0079
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0097
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0108
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0109
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0110
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0121
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0128
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0148
http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0158

Description
 Anathematic bas relief stele made by Pendelikon marble, representing goddess Cybele in a frame, sitting on a throne and fifteen of her worshippers to the right in religious reverence (thirteen men and two women). Under the throne, her symbol, the lion, is depicted. Cybele holds a saucer in one hand and a scepter in the other. She bears polos on her head. Dated to the late 4th century B.C. Dimensions: Height 0.51m, Width 0.78m, Thickness 0.12m.
 Location: Room 15, 1st floor.

Figure 14: Detailed Wikipedia-like view of the cultural heritage item MT0010 (Anathematic bas relief)

The WissKI system provided a useful platform for viewing and accessing the instantiated data of the CCKB. However, the system in its original form of distribution does not fully support the full range of CCKB semantics, particularly when building the Wikipedia-like views of data. For example, the system does not support annotation properties, such as *rdfs:label* or *skos:prefLabel*. Some modification to the original WissKI code was made to enable retrieval of data instances of non CIDOC-CRM classes, such as Reflective Topic. The most comprehensive view of the data is made available using the view of triples as shown in **Error! Reference source not found.**, which makes available the range of in-coming triples for a particular node (Object). The view makes available links to the nodes that ease navigation within the semantic structure.

Home - Navigate - Reflective Topics

Search

Tools

[Add content](#)

View Triples for http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009

View Edit Delete Triples Graph Merge

In-coming triples

Subject	Predicate	Object
http://wisski.infra.crosscult.uop.gr/wisski/navigate/1034/view	http://www.w3.org/2002/07/owl#sameAs	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://wisski.infra.crosscult.uop.gr/wisski/navigate/1034/view	http://www.w3.org/2004/02/skos/core#closeMatch	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E22/MT0002	http://kb.crosscult.eu/reflects	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E35/tl_rt_0000_0009	http://erlangen-crm.org/160714/P1021.is_title_of	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E35/tl_rt_0000_0009	http://erlangen-crm.org/160714/P11.identifies	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/im_0000_0008	http://erlangen-crm.org/160714/P67.21.is_media_of	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/im_0000_0008	http://erlangen-crm.org/160714/P671.is_referred_to_by	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/im_0000_0009	http://erlangen-crm.org/160714/P67.21.is_media_of	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/im_0000_0009	http://erlangen-crm.org/160714/P671.is_referred_to_by	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/im_0000_0009	http://erlangen-crm.org/160714/P67.41.is_narrative_of	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr/E73/m_0000_0009	http://erlangen-crm.org/160714/P671.is_referred_to_by	http://collection.tripolismuseum.gr/Reflective_Topic/rt_0000_0009
http://collection.tripolismuseum.gr	http://erlangen-crm.org/160714	http://collection.tripolismuseum.gr

Figure 15: WissKI view of triples of CCKB data relating to the Reflective Topic `rt_0000_0009`

5.2. CCCS TemaTres

TemaTres [11] is a web application for managing documentation languages, oriented to the development of hierarchical thesauri, on which several editors can be working at the same time. It allows both a systematic and an alphabetical list of terms, and offers different options to perform searches, such as simple search or expanded search through related or hierarchical terms. The application has been used in CrossCult for developing the CCCS and is available at <http://ccdev.uop.gr:5180/vocab/index.php>. **Error! Reference source not found.** presents a screenshot of the online application showing the top-level facets of the CCCS. The application supports the definition of hierarchical, equivalence and associative relationships, whereas thesaurus concepts can be annotated with scope notes, historical notes, bibliographic notes or private notes. **Error! Reference source not found.** presents an example of the hierarchical relationships of the concept “Religion”, which enjoys a two-level deep structure of narrower terms, including “Belief systems”, “Religious activities”, “Religious Communities”, etc.

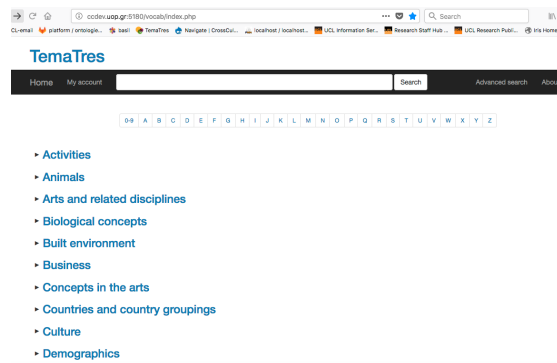


Figure 16: Top Level Facets of the CCCS resource

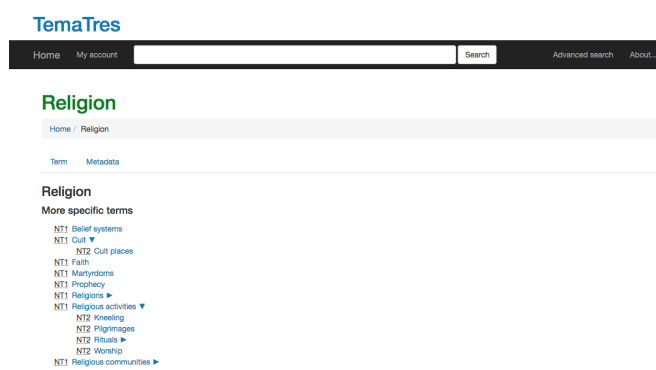


Figure 17: Hierarchical relationships of the term "Religion" in CCCS TemaTres

5.3. Blazegraph Workbench

Blazegraph is a standards-based, high-performance, scalable, open-source graph database. It is written in Java, and supports Blueprints and RDF/SPARQL 1.1 family of specifications, including Query, Update, Basic Federated Query, and Service Description. The CCKB is deployed in a Blazegraph triple store and is available at <http://ccdev.uop.gr:9999/blazegraph>. Error! Reference source not found. depicts the deployed version of the CCKB accessed through the Blazegraph Workbench online facility, running a sample SPARQL with the respective results.

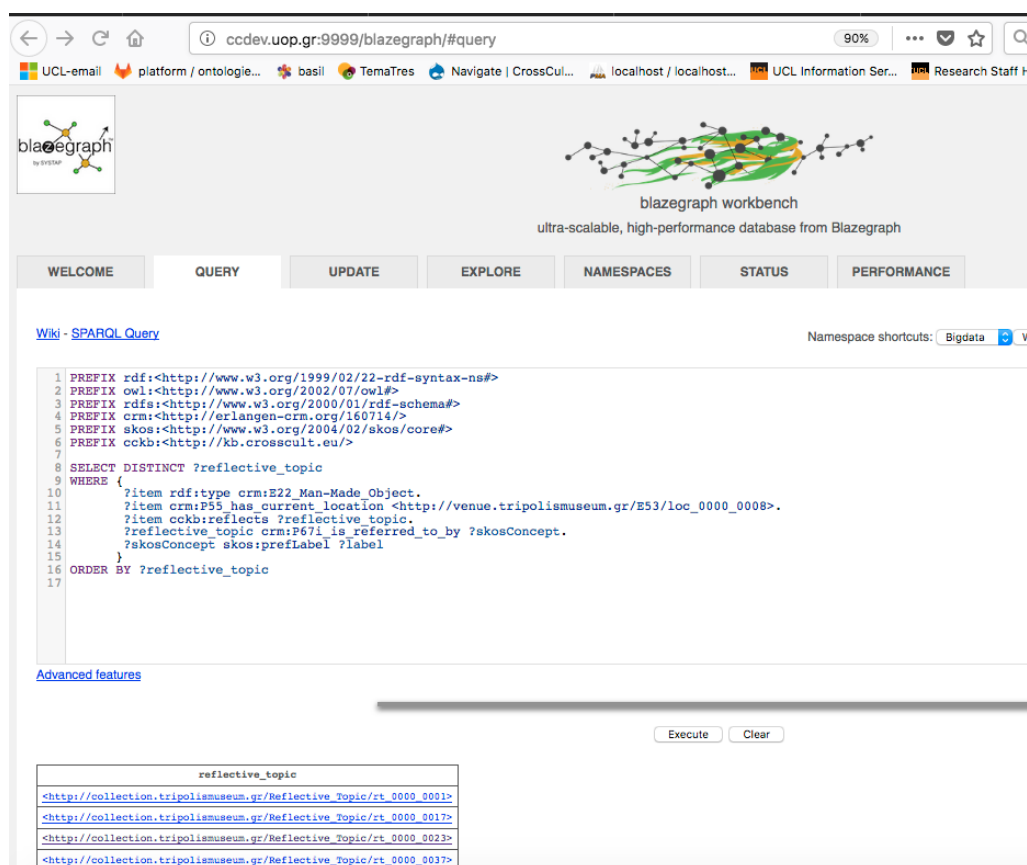


Figure 18: The Blazegraph Workbench instance of the CCKB running at the project's servers

6. Conclusions

This deliverable describes the status of the digital cultural resource data and data structure in M25, which have been modelled following the semantic definitions of the CCKB, described in deliverable D2.5. It builds on an earlier deliverable, D2.2, which presented our initial data modelling methodology and data modelling examples from the four pilots. This deliverable discusses further the details of the data modeling method revealing its stages and tasks in the process of homogenising disparate datasets under a common ontological layer. It also presents examples of semantic enrichment, information retrieval and association discovery between cultural heritage items and related information available from the CCKB, demonstrating the advantages and benefits of using semantics for retrieving information and revealing connections. Finally, it briefly describes three different front-end applications, each of which provides a different way of viewing and accessing the CCKB.

The CrossCult knowledge base and ingested data have been deployed on the project's triple store. Details on the installation and deployment of the CCKB are provided in deliverable D4.1, while further details on the different ways of accessing the CCKB are described in deliverables D4.2 and D4.3. Further ingestion of data (mainly from Pilots 1 and 4) will be carried out by WP5 according to the needs of the pilot apps, and following the methodology described in this deliverable.

References

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Appendix

1 SPARQL Query – Co-located items reflecting same Reflective Topic

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX crm: <http://erlangen-crm.org/160714/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX cckb: <http://kb.crosscult.eu/>
SELECT DISTINCT ?item ?reflective_topic ?reflective_narrative_note
WHERE {
    ?item rdf:type crm:E22_Man-Made_Object.
    ?item crm:P55_has_current_location <http://venue.tripolismuseum.gr/E53/loc\_0000\_0008>.
    ?item cckb:reflects ?reflective_topic.
    ?reflective_topic crm:P67i_is_referred_to_by <http://kb.crosscult.eu/skosConcept/990>.
    ?reflective_topic crm:P67_4_has_narrative ?reflective_narrative.
    ?reflective_narrative crm:P3_has_note ?reflective_narrative_note
}
ORDER BY ?item
```

2 Expanded SPARQL Query – Co-located items reflecting same Ref.Topic

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX crm: <http://erlangen-crm.org/160714/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX cckb: <http://kb.crosscult.eu/>

SELECT DISTINCT ?item ?RT ?reflective_narrative_note
WHERE {
    {
        ?item cckb:reflects ?RT.
        {
            ?RT crm:P148i_is_component_of ?reflective_topic.
            MINUS {?RT crm:P148_has_component ?component}
        }
        ?RT crm:P67_4_has_narrative ?reflective_narrative.
        ?reflective_narrative crm:P3_has_note ?reflective_narrative_note.
        {
            SELECT DISTINCT ?item ?reflective_topic
            WHERE {
                ?item rdf:type crm:E22_Man-Made_Object.
                ?item crm:P55_has_current_location
                <http://venue.tripolismuseum.gr/E53/loc\_0000\_0008>.
                ?item cckb:reflects ?reflective_topic.
                ?reflective_topic crm:P67i_is_referred_to_by
                <http://kb.crosscult.eu/skosConcept/990>.
            } } } }
}
```

3 SPARQL Query – Items about similar Reflective Topics across pilots

```
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX crm: <http://erlangen-crm.org/160714/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX cckb: <http://kb.crosscult.eu/>

SELECT DISTINCT ?item ?reflective_topic ?reflective_narrative_note
WHERE {
```

```

?item rdf:type crm:E22_Man-Made_Object.
?item cckb:reflects ?reflective_topic.
?skosConcept skos:narrower <http://kb.crosscult.eu/skosConcept/990>.
?skosConceptBroader skos:broader ?skosConcept.
?reflective_topic crm:P67i_is_referred_to_by ?skosConceptBroader.
?reflective_topic crm:P67_4_has_narrative ?reflective_narrative.
?reflective_narrative crm:P3_has_note ?reflective_narrative_note.
}

```

4 SPARQL Query – Calendar Based Association Discovery

```

PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX owl: <http://www.w3.org/2002/07/owl#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX crm: <http://erlangen-crm.org/160714/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX cckb: <http://kb.crosscult.eu/>

SELECT DISTINCT ?item ?reflective_topic ?extVocabularyURI ?date
WHERE {
  ?item rdf:type crm:E22_Man-Made_Object.
  ?item cckb:reflects ?reflective_topic.
  ?reflective_topic crm:P67_4_has_narrative ?reflective_narrative.
  ?reflective_narrative crm:P3_has_note ?reflective_narrative_note.
  ?reflective_narrative crm:P67_refers_to ?extVocabularyURI.
  {
    SELECT ?extVocabularyURI ?date
    WHERE {
      ?spDay crm:P2_has_type <http://kb.crosscult.eu/skosConcept/1652>.
      ?spDay crm:P4_has_time-span ?timespan.
      ?timespan crm:P82_at_some_time_within ?date.
      ?infoObject crm:P67_refers_to ?spDay.
      {
        ?infoObject crm:P67_refers_to ?extVocabularyURI.
        MINUS {?infoObject rdf:type crm:E73_Information }
      }
    }
  }
}

```