

# Mapping ICCD Archaeological Data to CIDOC-CRM: the RA Schema

A. Felicetti<sup>1</sup>, T. Scarselli<sup>2</sup>, M. L. Mancinelli<sup>3</sup>, F. Niccolucci<sup>1</sup>

<sup>1</sup>PIN, Università degli Studi di Firenze, Italy

<sup>2</sup>ICCU, Istituto Centrale per il Catalogo Unico, Italy

<sup>3</sup>ICCD, Istituto Centrale per il Catalogo e la Documentazione, Italy

**Abstract.** This paper describes the work carried out by PIN (University of Florence) and the MiBAC, in the framework of the ARIADNE project, for mapping the Italian archaeological documentation system to CIDOC-CRM. ARIADNE's primary goal is the implementation of interoperability among archaeological data at a European level, by creating a technological infrastructure for archaeological data sharing and integration. The Italian system is extremely articulated and complex, but the mapping activities, although at an early stage, are progressing very quickly. We are presenting here an overview of the conceptual mapping between the "RA" model (providing information on archaeological artefacts) and CIDOC-CRM, the reference ontology chosen by ARIADNE as a "common language" for integration.

**Keywords.** Archaeology, Mapping, CIDOC-CRM, Linked Open Data, Semantic Web

## 1 Introduction

The activities described in this paper fall within the framework of ARIADNE (Advanced Research Infrastructure for Archaeological Dataset Networking in Europe), an FP7-INFRASTRUCTURES-2012-1 EU project (Grant agreement no: 313193), whose primary goal is the integration of existing archaeological research infrastructures to enable the use of distributed datasets and services by means of new and powerful technologies as an integral component of the archaeological research methodology [1].

Nowadays there is a large availability of archaeological digital datasets, which differ in structure, aims and provided functionalities, representing the outcome of the research of individuals, teams and institutions that altogether span different periods, domains and regions. And since standardization is one of the main keys for integration, it is paramount in this particular moment to find a "common language" for the description of the huge variety of archaeological data available, to make them interoperable and to give the researchers the access to integrated archives for the enhancing of their research activities.

ARIADNE has chosen CIDOC-CRM [2] to implement such integration, and mapping activities have already started within the project to convert data and try to build integrated scenarios. In this paper we present the first phase of the activities carried out by MiBAC, the Italian Ministry of Cultural Heritage and Tourism, and PIN (University of Florence), for mapping the Italian national standards for the encoding of archaeological information, developed and maintained by ICCD, to CIDOC-CRM.

## 2 The ICCD and the Italian documentation for cultural heritage

The ICCD (Central Institute for Catalogue and Documentation) [3-4] is one of the seven Central Institutes of the MiBAC, whose main goal is to create a centralized national catalogue of the Italian cultural heritage. The activity of the Institute is based on the research and development of tools, methods and standards for knowledge, protection and en-

hancement of the Italian cultural and artistic heritage [5]. Among his most important tasks there is the management of the national general catalogue of archaeological, architectural, historical, artistic and ethno-anthropological heritage, the development of cataloguing methodologies and standards, the coordination of the technical institutions involved in the cataloguing activities on the national territory.

The ICCD is one of the main actors in the realization of the integration between the databases of the MiBAC and the ones of the local institutions distributed on the territory, by means of a number of “regional agreements” with the Regions and the Regional Offices. The Institute promotes dialogue with the territory intended to support the standardization and the integration in the national catalogue, on the basis of the compliance with its cataloguing standards. The agreements also represent the formal approval of a plan of cooperation with institutions put outside the Ministry itself (e.g. dioceses, universities) as part of a systematic action between the Institute and the territorial structures.

The relationship between ICCD and local authorities is fully oriented to the knowledge, the protection and the enhancement of cultural heritage. In this context, the ICCD also provides:

- Standards, methodologies and guides for the technological management of the general catalogue; the cataloguing procedures are monitored and estimated through the ICCD Observatory for Cataloguing (an internal committee in charge of the various management institutions and activities related with the cataloguing activities) [7].
- Tools for data management, and mainly the SIGECweb (Information System General Catalogue), a software web application created with the aim to unify and streamline processes related to the cataloguing activities of the cultural heritage, and to ensure, through the tight control of the applied procedures, the quality of the data produced and their compliance with national standards [8].

### 3 ICCD Cataloguing Standards

The ICCD *corpus* of cataloguing standards consists of regulations, support and control tools (vocabularies, lists of terms) and a set of rules and guidelines illustrating the methods to be followed for the acquisition and production of cultural heritage documentation [9]. In particular the *corpus* includes:

- *Regulations for cataloguing*, describing the data models and the Authority files [5], to be used for cataloguing activities.
- *Catalogue schemas*: descriptive models and forms for collecting information in a structured way, according to a “path of knowledge”. The ICCD issued different cataloguing schemas in relation to different types of assets, organized on the basis of the various disciplines (see below).
- *Authority files*, a complete control system to guarantee uniformity in the use of information concerning key concepts (e.g. authors, bibliography) used throughout the whole system. The Authority files are useful support tools for the standardization of cataloguing, and come as self-consistent databases to be connected with the cultural heritage ones. ICCD created and maintains four Authority files for archaeology, three of which are taken into account for the present paper: “AUT” (Authors), “DSC” (Archaeological Excavations) and “RCG” (Archaeological Surveys).
- *Support and control tools*: thesauri and terminological tools [6] developed to perform data acquisition operation in a uniform way by using similar criteria, and to create a “common and shared language”, essential for a correct use of information at query time and for the interoperability of cultural heritage data.

The system is the result of a long research work carried out within the ICCD, in collaboration with other institutions, to develop a model for the acquisition of data that could respond to the needs of a fast cataloguing without compromising a deeper knowledge of the assets. For what concerns the archaeological field, that is the argument of the present paper, the tools available at the moment for the cataloguing of movable and immovable archaeological properties (according to version 3.00 of the Regulation, recently released) are the followings:

- *SI Schema - Archaeological Sites*: used to describe and document an archaeological site, intended as a “portion of land that preserves evidence of human activities, belonging to a past more or less remote, and investigable with the proper methods of archaeological research”, with any regard to quality, quantity or size of the evidence.
- *SAS Schema - Stratigraphic Surveys*: used for the documentation of stratigraphic sequences found in contexts of archaeological excavations. The ICCD has an on-going research project for the automatic processing of the records for the detection of Stratigraphic Units, for which, so far, paper forms are the only source available.
- *CA Schema - Archaeological Complexes*, used for the documentation of archaeological properties, without regard of the current state of conservation, having a functional architecture easily identifiable *per se*, both from the physical and conceptual point of view, and composed of various building units (e.g. a fortified place, an *insula*, etc.).
- *MA Schema - Archaeological Monuments*: used for the recording of archaeological properties consisting of a single identifiable building unit (a tower, a *domus*, a temple, etc.), identified and organized on the basis of the functional units (circles) and partitions (walls, roofs, floors, etc.).
- *RA Schema - Archaeological Finds*: used for the recording of movable objects, it is the most used and well established standard for Italian archaeology, because of the very high number of artefacts, already available and continually increasing as a result of archaeological excavations, surveys and discoveries throughout the national territory, and the extremely heterogeneity of types, history and contexts of belonging. For its complexity and completeness, the RA schema is the one we have chosen to start our mapping activities from, as described in this paper.
- *NU Schema - Numismatics*: used for the recording of all the objects mainly having a monetary relevance, not only coins but also object possessing monetary connotation, including seals, ancient medals, coinage tools and weights.
- *TMA Schema - Archaeological Materials*: used for the recording of large collections of materials without significant characteristics or fragmentary, often coming from archaeological excavations or surveys, or stored in museums and private collections, for which it is not expected to use RA schema.
- *AT Schema - Anthropological Finds*: to record biological evidences in close relation with archaeological and paleontological, historical and cultural contexts, affecting the evolution, life and history of studies of the human race and its predecessors.
- *EP Schema - Epigraphic Model*: to record the various aspects of the epigraphic documentation. This model is still under developing.
- *US Schema – Stratigraphic model*: to record the various aspects of archaeological analysis. This model is still under developing.
- *TM Schema – Type wall model*: to record the various aspects of technical wall. This model is still under developing.

The logical organization and interoperability among the various standards listed above provides a comprehensive hierarchic framework for top-down analysis (i.e. from the general ‘territorial container’ represented by the archaeological site, throughout the archaeological complex, the individual monument composed of parts and subparts, straight to the

artefact) and, *vice versa*, to reconstruct the bottom-up sequences from the movable object back to the monumental and territorial context of belonging, according to a strong and articulated system of relationships between the various schemas, which is not rigidly pre-ordained, but can vary to fit different scenarios.

This ICCD reporting system allows, for example, to link archaeological assets of various types to the archaeological site, in which they were found, or to contextualize the stratigraphic investigations in the building, in which they were made (portion of land or monumental emergency), or even to establish correlations between assets of a certain functional or typological kind, to reconstruct funerary objects, collections of objects, sets of artefacts belonging to particular contexts. It is important to note that the whole cognitive process that the cataloguing standards provide is flexible enough to allow the recording of various levels of information, from a minimum number of fields (the so called “inventory level”) to a complete and detailed recording of complex data.

To enhance internal interoperability of the system, a parallel work has been carried out to provide all the models listed above with the so-called “cross-sections”, special information common to all the models, coming as transversal paths going through the whole system. The cross-sections represent the core, the basic information units around which the specific information and attributes are organized.

## **4 The ICCD Mapping to CIDOC-CRM**

After a deep analysis of the ICCD system, we have agreed that the RA schema is the most significant model of the ICCD archaeological cataloguing system, for its richness and popularity. We have chosen to use it as the starting point for the mapping activities to CIDOC CRM. In fact, RA records contain a huge amount of information for the description of archaeological objects, different types and relationships with other archaeological entities. Moreover, the massive presence in the RA schema of “cross-sections”, also present in other schemas, also constitutes a good base for the prosecution of the mapping activities [6-7].

To facilitate the comprehension of the conceptual mapping proposed in this paper, we have chosen to organise the RA information around some of the core concepts of the CIDOC-CRM, in order to give it a semantic order instead of following the functional sequence of descriptions of the RA schema. In fact, although these two sequences coincide in most cases, it is easier to explain the logic of the mapping using a CRM approach, being its model based on events, usually easy to pinpoint and analyse. This is even more necessary in a paper whose main purpose is not to describe in details the whole work carried out, but just to give a general idea of what has been done. Actually, where the words are limited to express such complexity, images could be more effective. For this reason we have tried to synthesize mapping concepts in various figures providing more details. But still, a full description of the whole process remains impossible in this little space.

### **4.1. Archaeological Object and Identifiers**

RA schema concerns the description of artefacts. From the CIDOC-CRM perspective, an artefact is a physical object purposely created by human activity. For this reason, the *E22 Man-Made Object* class has been used for representing the object, which the information in the RA schema refers to.

ICCD records and keeps track of a wide set of identifiers for each object, including the ones inherited by the local institutions contributing to the general catalogue. ICCD also assigns a specific “unique” identifier to the artefact, when it is recorded for the first time

in the ICCD archives. In particular, the “NCT” unique code serves as a ‘key’ to uniquely identify the artefact described in the record at national (Italian) level. It is generated by the combination of various subfields (sub-region code, catalogue numbers assigned by the ICCD). The “NCT” is the most meaningful identifier for the artefact, the one used as the primary and preferred identifier for it. For this reason we used the *P48 has preferred identifier* property of the CIDOC-CRM to relate it with the object.

Another important identifier, deserving to be mentioned here, is the inventory number (“INVN”) assigned by the local institutions responsible for the object (i.e. the museum, Superintendence, or private collector holding the property of the artefact).

The “NCT” identifier is already used by ICCD for the creation of uniform identifiers and can be also used in the future for the creation of the persistent URIs for the objects, and for LOD creation and publication.

## 4.2. Object description

This paragraph provides specific information coming from different sections of the RA schema, describing specific features directly possessed by the artefact and having no direct relation with the CIDOC-CRM events in which the object is involved. In particular ICCD records:

- *Object Definition*: term or expression that identifies the object on the base of its functional and morphological aspect expressed according to the tradition of the studies (e.g. “anfora”).
- *Specific Object Typology*: a term referring to the specific class to which the object pertains. This field is usually combined with Object Definition (e.g. “Dressel 20”).
- *Production Class*: category, class or type of production to which the object belongs.
- *Object Subject*: the subject or scene represented by the object (only for objects that represent themselves an iconographic subject).

ICCD provides specific vocabularies for the definition of the typological fields described above. All of them have been mapped on the *E55 Type* class, and linked to the archaeological object via the *P2 has type* property.

Other features directly referring to the object are:

- *Object Name*: the historical or traditional name of the object or its dedication name (e.g. “Olpe Chigi”). It corresponds to the *E35 Title* class.
- *Position*: this field represents a very peculiar case, since it indicates the name of the current object with respect to a larger object of which is part (e.g. “foot”, saying that the current object is a foot of, for instance, a statue). To render this concept, we have used the *E46 Section Definition* class and the related properties.
- *Title*: the title given by the author or the traditional name given to the object (i.e. “Apollo del Belvedere”), mapped on the *E35 Title* class.
- *Materials*: materials of which the object is made, described using the *P45 consists of* property and the *E57 Material* class. A specific vocabulary is provided.
- *Dimensions*: information concerning the various dimensions of the object (e.g. height, width, length, etc.), including the estimated monetary value of the object calculated on the currency at recording time. The *E54 Dimension* and the related properties (*P43*, *P90*, *P91*) have been used for the mapping of these fields.
- *Features carried by the object*: inscriptions (dedicatory, commemorative, honorary, etc.), stamps, badges, emblems and other features indicating e.g. the original property or provenance of the object. The RA schema devotes a special section to the description of these objects and their characteristics. For inscriptions, in particular, it records language, transcription, character set, writing technique and the cultural area of be-

longing (e.g. Roman or Greek epigraphy). CIDOC-CRM is particularly suitable for describing inscriptions and provides a complete set of entities and properties for it (i.e. the *E34 Inscription* class and the related properties) [8].

- *Physical conditions and state of preservation of the object.* We used the *E3 Condition State* together with the *P44 has condition* for the mapping, and the *E55 class* to record the terms of the controlled vocabulary provided by ICCD for populating this field.
- *Information on digital items*, such as pictures, drawings, multimedia, etc., documenting the object. The CRM *E36 Visual Item* and *E38 Image*, together with the *P138 has representation* property, have been used for mapping these fields.

### 4.3. Locations and Places

RA includes specific sections (“LC” and “LA”) for the description of the various locations where the object was produced or found, where is currently located or was located in the past. The terminology for the definition of these locations is based on the UNI-ISO 3166-1 standard (alphabetical list of country names) and on the standard lists of terms for the Italian administrative areas (regions, provinces and so on) provided by ISTAT (the Italian Institute for Statistics). The indication of all places on the Italian territory follows the ICCD standard path “Region > Province > Municipality > Locality”. For the purposes of the current mapping, these information could be easily enriched with GeoNames URIs, to enhance future interoperability (see Figure 1).

A list of the different location types recorded into the archive, with indications on how they were mapped to CIDOC-CRM, follows.

- *Current location:* is described in section “LC” (*Geo-Administrative Location*) with a set of fields providing identification of the geographic and administrative place on the Italian territory or to administrative-territorial organizations of foreign countries (in the case, for example, of objects held in areas pertaining to the Italian embassies) where the artefact was located at the moment of the ICCD record creation. To map the notion of “current location” to CIDOC-CRM, we linked the instance of *E53 Place* with the archaeological object through the *P55 has current location* property.
- *Provenance places:* described in section “LA” (*Other Geo-Administrative Locations*), it provides information not only for the geo-political localizations of the object’s previous places of conservation, but also for production and finding places, according with the “TCL” field (*Location Type*) whose value (*Provenance, Finding, Production*) determines the mapping to be followed. When the section refers to the object provenance, all the fields are assumed to be repeatable. This is very useful for the reconstruction of the object’s location history, i.e. the sequence of all the places in which it was present through time. CIDOC-CRM is very handy for this, since it also gives the possibility to define events able to relate places, actors and time spans, even if they are described in different sections of the original data schema. In this case, to relate the object with one of its provenance places, we have created the *E10 Transfer of Custody* event and specified the provenance place by using the *P7 took place* property. The object participation in this event is defined via the *P30 custody transferred through* property.
- *Production and Finding Place:* the information of section “LA” refers to the corresponding place type with “TLC = Production” or “TCL = Finding”. Details on these place types are provided in the “Production” and “Finding” paragraphs of this paper. Figure 1 illustrates the general mapping schema of ICCD locations and places. Information concerning each place described in the archive includes:
- *Specification of the architectonic or functional typology* of the place or building in which the object is currently located or /was located in the past (e.g. “Museum”, “Ab-

bey”, “Monastery”). ICCD provides typological thesauri for these fields, which can easily be mapped using the *P2 has type* property, and assigned to the specific *E55 Type*.

- *Denomination*, i.e. the full name of the place, building or complex where the object is currently hosted or /was hosted in the past. For the name of buildings ICCD makes reference, where possible, to official sources (e.g. the “Diocesan Yearbooks” for church buildings). The *E44 Place Appellation* is used to assign denominations to places. The *P89 falls within* property is used for stating the mutual relationships among different places (e.g. between a building in respect to the complex it belongs to).
- *Addresses*, mapped on the *E45 Address* entity.
- *Denomination of the collection* which the object forms (or formed) part of (*P46*), hosted in a specific place (*P55 has current location*).
- *Related date*, i.e. the date on which the object was placed in the museum/building (*P26*) and the one in which he was transferred elsewhere (*P27*).
- *Spatial coordinates* (*E47*) defining the points needed to identify (*P87*) and georeference the place where the object was held or is currently located. Spatial coordinates also refer to all the other place types described by ICCD (see below). Information on specific techniques and methods used to acquire the coordinates are also provided.

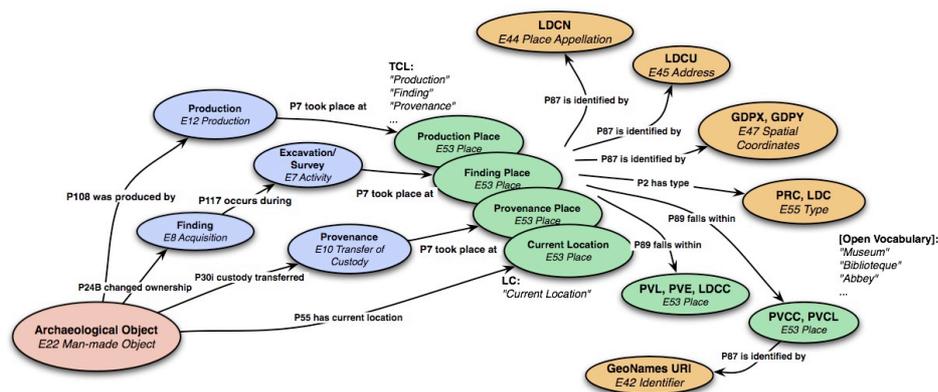


Fig. 1. CIDOC-CRM mapping of the ICCD-RA locations and places information

#### 4.4. Finding

The finding event is a very important event in archaeology, representing a corner stone in the reconstruction of the object’s history. From the CIDOC-CRM point of view, the object finding is a kind of acquisition (*E8*) that can occur during (*P117*) an archaeological survey or excavation (*E7*) and changes the object’s ownership (*P24B*), which is acquired by the institution performing the discovery. The ICCD RA schema provides, in the “RE” section, a wide bunch of information concerning finding activities, and in particular:

- ICCD unique identifier (through the “DSC” Authority file) and Excavation inventory number (*E42*).
- Official name and description of the archaeological excavation/survey, mapped as instances of *E41 Appellation*.
- Information concerning institutions, scientific coordinators and other people responsible or involved in the survey/excavation, during which the object was found. Each of them has been mapped as an instance of *E39 Actor*.
- Survey/excavation motivations (*P17*, e.g. “Rescue archaeology”).

- Methods and techniques (*P32* -> *E55*) used to perform the excavation/survey activities. Terms to specify this field are taken from a specific vocabulary.
  - Time spans (*P4* → *E52*)
  - Specific bibliography, documenting (*P70*) the finding activities.
  - Finding places: a set of fields providing information on the place where the object was found (section “LA” with “TCL = Finding”)
  - Stratigraphic units, tombs and other locations where the finding took place (*P7*).
- Figure 2 shows the mapping rationale of the “Finding” event and the related entities.

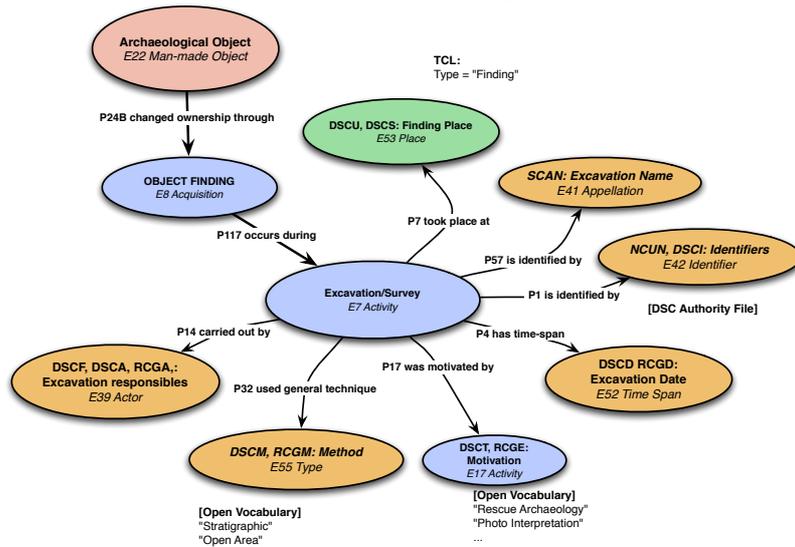


Fig. 2. Mapping schema of the ICCD-RA “Finding” event.

#### 4.5 Production

Production is a very complex process, involving various objects, people and places. Documenting it in the proper way is paramount when dealing with archaeological artefacts. In a similar way to what we have done for the finding, we have defined a production event (*E12*) able to relate each other the various places and actors involved. The archaeological object’s production is specifically referenced by the *P108 was produced by* property.

Production is described using data coming from various sections of the ICCD schema, in which we find all the information to describe the creators and the techniques involved in the object production process (*P32*), but also notices about the group of artists or the school and other similar concepts related to a more general cultural context. ICCD, as already mentioned, defines a specific Authority file for the “authors” (“AUT”), providing unique identifiers to be used here for the unambiguous identification of all the actors participating in the production process. We used the *P14 carried out by* to relate these actors with the production event (*E12*).

ICCD also records information concerning the reasons for the attribution of the object to a certain cultural context. We have rendered this attribution process by using the *P140 was attributed by* property and the *E13 Attribute Assignment* event. ICCD provides a controlled list of terms for production attributions, which we used to define the attribution type (*E55*, e.g. “stylistic analysis”).

The schema also contains fields providing specific information on production place, if known.

#### 4.6. Acquisition

The ICCD *Acquisition* section (“ACQ”) records information related with the acquisition and the legal *status* of the artefact, the protective measures concerning it and information related with the circumstances under which the object has been received and is located in the current conditions of property or detention. Since institutions may have various ways for acquiring an archaeological object (e.g. after a finding or by a purchase, a donation, an exchange, etc.), ICCD has specific vocabularies for the definition of acquisition types (mapped on *P2*). The Acquisition event (*E8*) in section “ACQ” is considered as the changing of ownership of the artefact through a transfer of title from a former owner (*P23*) to a new one receiving its ownership (*P22*). The section can appear many times to document the acquisition chain occurred during the object’s lifetime.

The “ACQ” section also records the acquisition dates and places, and provides details concerning the actors (people or groups) involved in the event. For the latter, the *P52 has current owner* is used to define the last recipient, in our case the institution that created the record (*E39*).

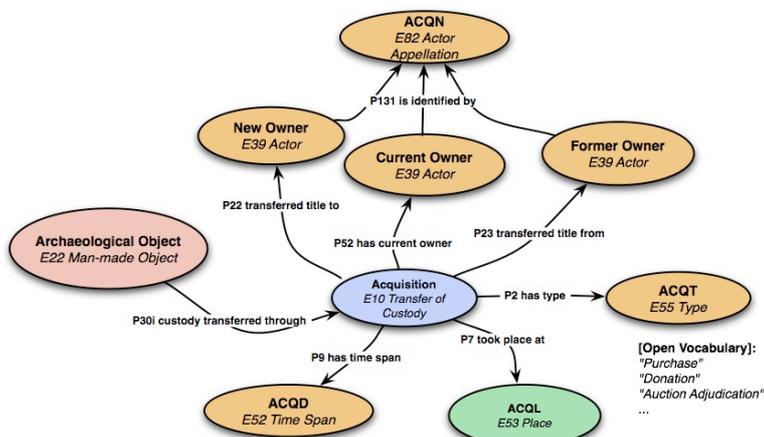


Fig. 3. The Acquisition process and the “ACQ” section of the RA model.

#### 4.7. Objects dating

Dates are usually very problematic information to manage, for their notorious imprecision which always makes it impossible to record them in a standard way. In ICCD RA model, we find various chronological indications for dating the objects, including periods of reference (e.g. “Middle Neolithic”), centuries in Roman numerals, numeric expressions followed by the indications a.C. (BC) or d.C. (AD) (e.g. “III sec. a.C.”), and chrono-cultural definitions (e.g. “Roman Age”).

Since historical periods do not possess universally agreed start and end chronological limits, we have used the *E4 Period* entity to represent them and the *P10 falls within* to establish relationships with the object production event (*E12 Production*). Sometimes ICCD provides a single date or *termini ante* and *post quem* for the definition of data ranges. In this case the *P82 at some time within* property has been used.

As in the case of the reasons for the attribution of production to a certain cultural context, ICCD provides information concerning the reason for the proposed dating of the object (the “DTM” field, *dating motivation*). In a similar way to the above, we have rendered the dating attribution process by using the *P140 was attributed by* property and the

*E13 Attribute Assignment* event. A controlled list of terms for dating motivations, used to define the attribution type (*E55*, e.g. “chemical analysis”), is also provided.

#### 4.8. Internal ICCD cross references

A special section of the RA schema states direct relationships between entities catalogued using the ICCD system. These relations are only specified if both the objects (the one described in the current record and the one referenced from this section) are present into the ICCD database. The field “RSER”, in particular, defines the nature of the relationships described in this section and as a consequence, from the point of view of the mapping, the path that should be followed according with it. The same field can also determine the place type (i.e. the current location, the provenance, the finding or the production place, similarly to what “TCL” field does) involved in the relation. The “RSEC” and “RSET” fields indicate the object type of the referenced asset and its unique identifier.

#### 4.9 ICCD RA Bibliography

The ICCD, while not providing the completeness typical of library databases, records a well-detailed bibliographic information set concerning the archaeological objects. In the mapping, the object is linked via the *P70 is documented in* property with its bibliographic record (*E31 Document*), which in turn has been created by an event (*E65*) having specific actors and creation dates. The “AUT” Authority file is used for authors’ definition. The *P3 has note* property has been used to assign the full citation to the document itself.

## 5 Mapping Example

In the following table we propose a real example of mapping of an artefact (Olpe ‘08-487640’), found in 1969 during the excavation of the archaeological area of Sasso Marconi and exhibited in the Etruscan National Museum of Marzabotto (Bologna, Italy). Details of the mapping paths (column 2) and of the ICCD vocabularies used (column 3), are also provided.

ICCD RA	CIDOC-CRM Mapping	Vocabularies
NCT - Codice univoco	E22 Man-Made Object - P48 has preferred identifier - E42 Identifier '08-487640'	
OGTD - Definizione	E22 Man-Made Object - P2 has type - E55 Type 'olpe'	Open Vocabulary
CLS - Classe e produzione	E22 Man-Made Object - P2 has type - E55 Type 'contenitori e recipienti'	Categories
PVCC - Comune	E22 Man-Made Object - P55 has current location - E53 Place P89 falls within - E53 Place 'Marzabotto'	ISTAT Names
LDCT - Tipologia	E22 Man-Made Object - P55 has current location - E53 Place P2 has type - E55 Type 'museo nazionale'	Open Vocabulary
LDCN - Denominazione	E22 Man-Made Object - P55 has current location - E53 Place P87 is identified by - E44 Place Appellation 'Museo Nazionale Etrusco «Pompeo Aria»'	
INVN - Numero	E22 Man-Made Object - P1 is identified by - E42 Identifier '1437'	
SCAN - Denominazione dello scavo	E22 Man-Made Object - P24B ch. own. thr. - FINDING (E7 Activity) P57 is identified by - E41 Appellation 'Sasso Marconi, Via Porrettana 252/3'	

DSCF - Ente responsabile	FINDING - P14 carried out by - E39 Actor 'SBA-ERO'	
DSCT - Motivo	FINDING - P17 was motivated by - E7 Activity 'opere private'	Open Vocabulary
DSCD - Data	FINDING - P4 has time-span - E52 Time Span '1969'	
MTC/M - Materia	E22 Man-Made Object - P45 consists of - E57 Material 'bronzo'	Open Vocabulary
MTC/T - Tecnica	E22 Man-Made Object - P108 was produced by - E12 Production P32 used technique - E55 Type 'laminatura, fusione'	Open Vocabulary
DTZG - Fascia cronologica di riferimento	E22 Man-Made Object - P108 was produced by - E12 Production P10 falls within - E4 Period 'sec. V a.C.'	
DTM - Motivazione cronologia	E22 Man-Made Object - P108 was produced by - E12 Production P10 falls within - E4 Period P140 was attributed by - E13 Attribute Assignment 'contesto' 'analisi tipologica'	Open Vocabulary
MISU - Unità	E22 Man-Made Object - P43 has dimension - E54 Dimension P91 has unit - E58 Measurement Unit 'cm'	Closed Vocabulary
MISA - Altezza MISD - Diametro	E22 Man-Made Object - P43 has dimension - E54 Dimension P90 has value - E60 Number '18,4' '8,8'	
DESO - Indicazioni sull'oggetto	E22 Man-Made Object - P3 has note 'Bocca rotonda, labbro estroflesso, brevissimo collo troncoconico, corpo globulare senza soluzione di continuità con il fondo etc.'	
STCC - Stato di conser.	E22 Man-Made Object - P44 has condition - E3 Condition State 'reintegrato'	Closed Vocabulary
ACQT - Tipo acquisizione	E22 Man-Made Object - P24 ch. own. thr. - E10 Transfer of Custody P2 has type - E55 Type 'scavo'	Open Vocabulary
ACQD - Data acquisizione	E22 Man-Made Object - P24 ch. own. thr. - E10 Transfer of Custody P9 has time span - E52 Time Span '1969'	

## 6 Data Conversion and Publication

The conceptual mapping described in this paper is the logical base on which data encoded with the RA model can be converted in a CIDOC-CRM RDF format. Implementation of the real data conversion can be performed in various ways, but of course, the most suitable one would be using the exporting features already provided by SIGECWeb. The official ICCD software, in fact, is already able to export information concerning entities, cross-references and internal relationships, in various ways. The preferred and most used one is the ICCD "exporting package", mainly a set of directories containing textual data descriptions and multimedia files. Since the textual information always remains compliant with the various ICCD models, implementing the mapping framework and converting it directly in RDF is very straightforward. The system is also able to export data in XML, which would further simplify the converting operations and the generation of semantic data in Linked Open Data format.

Anyway, the ideal scenario would be reached by implementing new SIGECWeb modules and facilities for the direct CIDOC-CRM RDF exporting, and the direct publication of semantic information as Linked Open Data on the institutional websites of the MiBAC. This would simplify the conversion operations and constitute a tremendous step forward on the road of the interoperability of cultural heritage information. Publication would also

be straightforward, since the MiBAC online infrastructure already provides many RDF frameworks for the hosting and management of semantic information, together with various SKOS and Linked Open Data facilities for the semantic web implementation [9].

## 7 Conclusions and future work

The RA Schema is only the beginning of a wide activity that will be carried out by the ARIADNE project in collaboration with ICCD and other institutions related with MiBAC. The mapping of this complex schema has already demonstrated, at least from the logical point of view, the coherence with CIDOC-CRM and a wide compatibility with its schema. Though, a lot of work remains to be done. ICCD is still completing its model, and a version 4.00 of the recommendations for cataloguing, making it even more rational, is going to be released. From the other side, CIDOC-CRM is also evolving and an extension specifically designed to capture the concepts of the archaeological field is going to be released as part of the ARIADNE outcomes. The RA mapping will surely constitute a good starting point for the future convergence of the two models. And, on top of it, common concepts and elements like the cross-sections will make the mapping of all the other ICCD archaeological schemas easy and fast to be performed.

ARIADNE will assist ICCD in building and evaluating this process in every phase, from logical mapping to physical conversion of archaeological data. ARIADNE is also carrying out similar activities with other European archaeological institutions (partners of the project) to achieve, in a near future, its main goal: the implementation of interoperability among archaeological data at a European level.

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