Networking EAGLE with CIDOC and TEI

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1 Introduction

The Europeana network of Ancient Greek and Latin Epigraphy (EAGLE) brings together most repositories of ancient epigraphical documents and aims to provide scholars not just with a "useful" research tool, but with a curated online edition which has high quality contents as well as high quality data.

In this paper, the choices of the EAGLE BPN will be presented as a case of decisions about data driven by the community need for multiple approaches and the desire to enlarge the existing network.

The EAGLE Best Practice Network chose multiplicity of editions, interactivity, engagement and multilingualism in order to offer a complete and critically structured endpoint to the user. To encode inscriptions, EAGLE developed a metadata format that assessed the provider's metadata structures and considered two sets of standards: TEI EpiDoc and CIDOC CRM.

EpiDoc[4] allows a full description of the text of inscriptions. CIDOC CRM enables a further full description which is instead oriented to consider inscriptions as objects, thus reflecting the different souls of Epigraphy, the philological and the Archaeological one, pushing the boundaries of filing and collecting in order to meet the deepest intellectual needs of research.

The EAGLE BPN choice of the two standards grants full meaning and all possibilities to connect and link other data with external annotation or by alignment. Beside usefulness, the choice of complexity will be rewarding as a choice of semantic quality, but entails deeper changes of perspective.

2 EAGLE and Digital Epigraphy

In few years, thanks to the efforts of a community to follow on the developments of the digital revolutions, an almost entirely new discipline emerged beside traditional epigraphy. *Digital Epigraphy* explores new ways to bring to epigraphy

[4] Elliott et al. 2007.

the newest and most appropriate ways to encode data and produce high quality digital editions of one document or of an entire *corpus* of inscriptions. Digital Epigraphy brought to the world of epigraphy not just tools and possibilities to solve old problems but also many deep changes in perspective and new scientific questions.

Members of the EAGLE Network[5] are traditional scholars in epigraphy who see the potential of Digital Epigraphy, but also universities, institutions and researchers who work in other related sectors (3D modeling, museums, user engagement professionals, information technology, etc.). This composition of the Network aims at EAGLE's goal to enable digital access to epigraphic resources, not only for researchers but also for the general public:[6] a task which cannot be carried on without continuous interaction of different sectors.

To do this EAGLE BPN on one side definest tools and standards[7] and on the other follows established standards and guidelines for metadata and encoding to enhance searching and browsing and bring relevant contents to the users according to their needs. By creating a seamless and centralized online database, EAGLE is providing access to its project partners' epigraphic collections and archives. EAGLE content will also be ingested in Europeana[8] to become part of the biggest European culture portal and contribute to its mission to "transform the world with culture", knowledge and education.[9]

3 Epigraphy and Digital Epigraphy

The history of Digital Epigraphy is already quite long[10] and finds its origin in the '80, when a strong proposition was made to unify editorial criteria for Epigraphy.[11] First attempts were made also with dedicated software[12] and the PETRAE project has marked a decisive step in this direction. Major initiatives, as the Packard Humanities Institute Greek Epigraphy project become real at the end of last century and had to use their own approach for a lack of common standards which did not exists at that time. The main change happened when in 1999, Prof. Silvio Panciera encouraged the use of DTD for epigraphy, and consequently the first guidelines on the use of XML and especially TEI were proposed to encode inscriptions.[13] The consortium which was born from there, is the one that still now runs the largest part of digital projects in papyrology

[5] Orlandi, Giberti, and Santucci 2014, Liuzzo 2014.
[6] `http://www.eagle-network.eu/`
[7] Liuzzo, Pietro and Evangelisti, Silvia and Verreth, Herbert 2014.
[8] Europeana; Europeana Professional - Polymath Virtual Library.
[9] See the Europeana Fundation Strategy 2015-2020.
[10] Full and updated documentation can be founf in the Digital Classicist website.
[11] Krummrey and Panciera 1980; Panciera 1991.
[12] `http://www.csad.ox.ac.uk/CSAD/Newsletters/Newsletter4/Newsletter4b.html`
[13] For definitions and scope, see `http://www.stoa.org/epidoc/gl/latest/intro-eps.html`. For a complete overview of the origin, aims and development of EpiDoc, see Cayless et al. 2009, 17f.

and epigraphy, and has influenced an entire generation of digital editions of inscriptions. As SEG Online, the Berlin Academy of Sciences and many other small and medium projects took this path and started to do encoding in TEI, new projects of broader scope and already looking at the Linked Open Data world emerged and became a constitutive part of this research community.[14]

If the initial needs were to have a homogenous use of diacritics, soon epigraphists and digital epigraphists, both as encoders and researchers, had in their hands a semantic representation with unimagined potential. In the latest years, although new projects only slowly emerged and slowly developed, a great achievement was pursued with the publication of the Papyrological Navigator, a tool using the experience of the Son Of the Suda Online project to develop a collaborative platform based on XML to bring to the scientific comunity the most complete database of documentary papyri currently available. Succesively the direction taken has then been that of Linked Open Data and the network of the interested people and disciplines clustering expanded largely thanks to the effort of the LAWD (Linked Ancient World Data). The new projects and standards were followed by the Digital Epigraphy community and attempts were made to map EpiDoc to an Ontology or Linked Open data.[15] The EAGLE BPN attempts to fill also that gap by providing the largest possible community with the tools and support needed, at different level and for different purposes, to produce digital editions and understand the underlying methodologies and concepts. The distance which the digital epigraphist had to cover to be up to speed with the digital revolutions was far too much and inevitably produced a gap. EAGLE BPN, with its network efforts, tools and activities, aims to bridge part of that gap, because the potential is all in the interaction of fields of research. [16]

4 The EAGLE Metadata Model

The EAGLE BPN faces the challenge of restructuring towards LOD an entire field of knowledge with a very specific aim, while networking with other stakeholders in the field and ensuring that all what is needed is done to bridge the gap between digital and non digital epigraphy. One of the key points is the potential that Digital Epigraphy brings to the traditional discipline to reach a broader audience. The encoding of epigraphic *corpora* brings in fact the potential of interconnections between Epigraphy, Digital Epigraphy projects, cultural institutions dealing with Epigraphy (Museums, Universities, Schools, Archeological sites, etc.) and the public to the surface and it is therefore foundamental to the empowerment of all the connections relegated in a niche of academic research so far.

The EAGLE BPN had then to

[14] See the contributions in ISAW Papers 7.

[15] Álvarez, García-Barriocanal, and Gómez-Pantoja 2010.

[16] This begins to become clear, for example from the latest EAGLE workshop and conferences. See the EAGLE 2014 proceedings for several etherogeneous examples, forthcoming.

– deconstruct the information
– decide for a new structure which could remain peculiar and at the same time allow inclusion and articulation
– create tools to shorten or annihilate the gap between digital and traditional researchers.

To achieve this, the technical aspects of digital epigraphy needs to undertake major efforts to meet the needs and requirements of their user community. Among these efforts is the establishment, mapping and interconnection with existing and new data model and description frameworks.

The conceptual models which have been used to perform a mapping of the members of the EAGLE BPN which provide content for the project (Content Providers)[17] fit in a uniquely valuable way all the kind of data which are stored and studied by the participating databases.

Content providers use different models according to historical reasons, needs and intents of the different projects. Some databases are more oriented towards the text of an inscriptions, others on the object or monument carrying a text, but always the two natures of the inscribed document coexist.

The 14th international symposium of Greek and Latin epigraphy, "*Publicum, Monumentum, Textus*", changed the traditional approach pointing to the audience first to the object at a second stage and only at the end to the text which until recently was the predominant focus of Epigraphy. Research today must take into account the inscribed monument and strive not to favor one aspect instead of the other, leaving the amphora to the archaeologist to keep just the stamp, or the dedication leaving the architrave. The semantic value of the inscription is therefore even more important and more vital to the research.[18]

[17] Sapienza, University of Rome with EDR, University of Bari "Aldo Moro" with EDB, Heidelberg University with EDH, Oxford University with LSA, Univesity of Alcalà with HispEpOnline, Paris Lodron University Salzburg with Ubi Erat Lupa, Institut de recherche sur l'Antiquité et le Moyen-Age "Ausonius", UMR 5607, University of Bordeaux 3 CNRS with the new PETRAE project, Katholieke Universiteit Leuven with Trismegistos, Babe-Bolyai University, Eötvös Loránd University, Juraj Dobrila University of Pula, Scientific Research Centre of the Slovenian Academy of Sciences and Arts Institute of Archaeology, German Archeological Institute with Arachne, The Cyprus Institute and the Archaia Kypriaki Grammateia, The British School at Rome with the Inscriptions of Tripolitania and Etruria were the funding memebrs. Affiliated members include University of Venice, Split Archaeological Museum, University of Trieste, University of Foggia, Cheshire West Museum, Archaeological Institut of Kosovo, University of Palermo, University of Pavia, University of Beograd, University Johannes Gutenberg (Mainz), Università di Bologna, Università di Firenze, Università di Genova, Gloucester Museum, IEMEST, Center for comparative studies of ancient civlizations, Russian Academy of sciences. Together with these a number of projects and institutions has also joind in partnerships with EAGLE: the Perseus Project, Pelagios, Ancient History Encyclopedia, University of Belgrad, the Pontificia commissione di Archeologia Sacra and many more (see `http://www.eagle-network.eu/about/partners/`).

[18] The major efforts in defining this into a model are currently undertaken by the project *Épigraphie et Muséographie - Édition numérique et valorisation de la Col-*

On the side of data models to describe this kind of information the EAGLE consortium found two sets of standards towards which a mapping could be made, and which could then be mapped to the Europeana Data Model (EDM), to be ingested in Europeana:

- the EpiDoc Standard, based on TEI, which offers a full way to give a description of the textual document and is part of the latest history of the discpline;

- The CIDOC CRM, which is explicitly object oriented and offers an articulated way to best describe an object but presents big challenges for both the traditional and digital epigraphist.

The EAGLE metadata model, developed within the project consortium, has tried to map all content providers data to both these international standards, and has worked also towards a mapping among the two, based on the data of most of the major inscription databases.

While Epidoc/XML met all requirements, the broader aim of the CIDOC CRM presented many interesting challenges. EpiDoc has been chosen by most also as an export format so that the use of this standard and the availability of data already in EpiDoc for future project and research is already accessible. EpiDoc allows the content to be fully described for what concerns the text of inscriptions, since it is already experimented for more than a decade in this field. On the other side, the descriptive part of the EpiDoc guidelines lacks the articulation and the potential of the CIDOC CRM.

The mapping to CIDOC CRM allows expression in RDF not only of elements and attributes but of entities and properties which relates the different values, allowing for an event based description which is much more precise and unambiguous especially concerning the object itself. [19]

URIs are introduced at every stage with the purpose to enrich and harmonize contents.

The mapping to CIDOC-CRM is also the one which would allow for the inclusion in the EAGLE Metadata Model of all those extremely important contextual items which are part of the contents provided by Members of the consortium. For example, the users of the EAGLE datasets could then be able to retrive all inscriptions on an altar, but also all altars which do not have an inscription, so that the possibility to do top quality research will be further enhanced.

The EAGLE BPN undertook a major effort of data architecture, taking on board both encoding with their peculiarities, requirements and possible effects. The Conceptual model proposed and developed by the EAGLE project allowed in fact to encompass the heterogeneity of data in one model which includes all the mapped elements without need of flattening to one "minimum" common denominator. The EAGLE metadata model operates then a major alignment

lection des inscriptions grecques du Musée du Louvre lead by Michèle Brunet (ANR-12-BSH3-0012).

[19] Hyvönen 2012.

and description task avoiding to opt out between a description oriented to the object and one oriented to the text.

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5 EAGLE and CIDOC CRM

This section presents the first results of the study towards a mapping to CIDOC CRM of epigraphic contents.[20]

5.1 High-Level model

Epigraphic objects are represented as instances of E84 Information Carrier,[21] which is a particular case of man-made object and provides the way for describing all the physical characteristics of monuments: dimensions, materials, state of preservation; and also for distinguishing the objects by names or any other identifiers. There are two types of information carrier objects: those who bear an inscription and those who do not.

If the monument bears an inscription, this can be represented through the use of an E34 Inscription object and related to the information carrier using property P128 carries. Inscription objects will be represented explicitly, along with all the physical features of the Information Carrier related to it.

Any other information related to immaterial items that refer to the inscription, such as transcription text, translation text, bibliography, critical apparatus, commentary and the different type of surrogates, will be represented by instances of E31 Document.

Circumstantial information regarding the object such as place and date of finding will be represented by instances of E53 Place and E4 Period respectively. History of the object, including transfer of custody between individuals and organizations and curation activities will be denoted using objects of type E7 Activity and its descendants. This high-level model is schematically depicted in Fig. 1.

5.2 Low-Level model

The low-level model explains in detail both physical and documental characteristics of epigraphic objects.

[20] For a complete specification of CIDOC CRM entities and properties we refer to `http://www.cidoc-crm.org/html/5.0.4/cidoc-crm.html`

[21] Alexiev 2012.

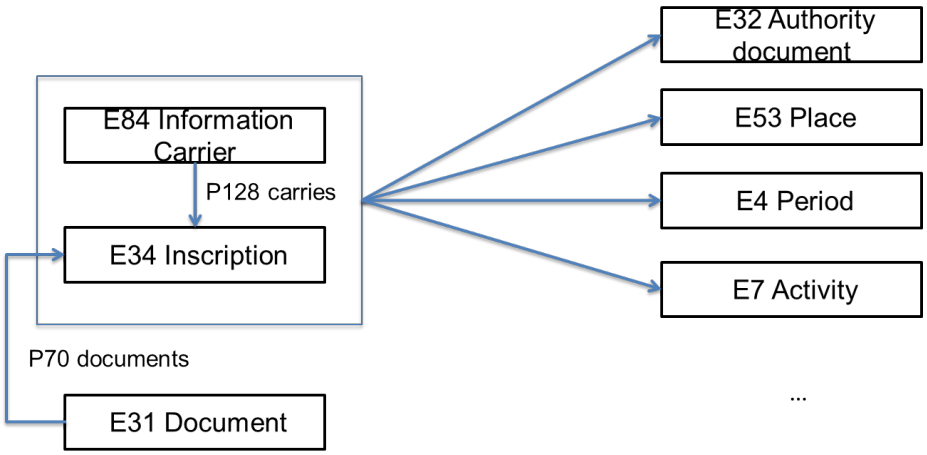

Fig. 1. High level model

Identification information The identification information of monuments is specified using an instance of E42 Identifier related via property P1 is identified by; this identification will consist mostly of the unique inventory number assigned to that monument within the institution which it belongs to. For inscriptions, identification information may include the Trismegistos number[22] that can be assigned to an epigraphic document in order to create a

binding to the Trismegistos document that represents the same epigraphic object, which is the base for the disambiguation process.

The title used to help identify monuments and inscriptions is specified by an instance of E35 Title and related to the carrier via property P102 has title.

Physical description Monuments can be made of one or more materials, each of which will be represented as an instance of E57 Material and related to the information carrier via P45 consist of. Materials and the rest of types in the model are built as EAGLE controlled vocabularies.[23]

Dimensions of monuments, inscriptions letters and epigraphical field are represented using objects of type E54 Dimension and related via P43 has dimension. At the same time, the units used for the measurement are specified through instances of E58 Measurement Unit and related to E54 Dimension via property P91 has unit.

The different options that may classify the inscriptions are represented using an element of type E55 Type and related via property P103 was intended for.

[22] A unique identifier assigned to each inscribed text.

[23] Liuzzo, Pietro and Evangelisti, Silvia and Verreth, Herbert 2014; Harper et al. 2012. The vocabularies are the following: Type of Inscription; Object Type; Material; Writing and Execution ; Decoration; State of Preservation; Dating Criteria.

In a similar way, the type of monument is specified through the same E55 Type but related to the E84 information Carrier object via property P2 has type.

For the description of the status of conservation of the object, an instance of E3 Condition State is used to register the different preservation states that can be associated to the object like broken or lost. This entity is related to the carrier object via property P44 has condition.

Information about history The process of creation of a man-made object is modeled in CIDOC-CRM using a particular case of E7 Activity. Activities involve both complex and simple actions and can be of great diversity including E10 Transfer of Custody, E11 Modification, E65 Creation or E87 Curation Activity, among others. A special case of Modification is E12 Production, which is used here to represent the activity that gave as a result the creation of a new item. The Production activity is related with the carrier object via property P108B was produced by.

There are some characteristics related with the creation process of an epigraphic object such as engraving technique, ancient and modern place of finding and the period of finding that will be specified as follows.

For the engraving technique, an instance of E55 Type is used related via P2 has type.

For the representation of the approximate date of finding, an instance of E52 Time Span is used, which consist of abstract temporal ranges described by initial moment, culmination moment and duration. This entity is related with E12 Production via property P4 has time span. E52 Time Span is farther detailed using instances of E61 Time Primitive which provides a way to express date intervals applicable to cultural documentation. This entity is related to E52 via property P82 at some time within.

If there is a relevant period of time, into which we can situate the approximate date of finding of the object, this one is specified through an instance of E4 Period. This entity is identified by the existence of a cultural or physical phenomena related in space and time, although its relevance is marked by the actual phenomena and not the time-space information. The relation with E12 Production is established by property P10 falls within. Temporal information associated with an E4 Period is detailed using an E52 Time Span and related via P4 has time span. The specific temporal data is represented through property P82 at some time within linking instances of E61 Primitive Time.

The ancient place where the epigraphic object was found is represented as an instance of E53 Place and related to E12 Production via property P7 took place at. At the same time, this instance is related with another instance of E53 that denotes the roman province within which the ancient find spot can be located. E53 Place covers space extensions from a physical point of view and no relation with temporal information.

The location of the epigraphic object is indicated by instances of E53 Place. CIDOC-CRM has a way of dealing with references to places that is: start from a "small" location element and create a chain by linking to a broader element

that contains the first one using property P89 falls within. Thus, in our case, instances of E53 Place represent the different levels of location of the object, covering, from the narrowest to the broadest, collection, repository (museum), settlement, region and country, all of them, linked in that order by P89 falls within.

The action of finding the object is illustrated by an instance of E7 Activity, involving information about the year of finding represented using instances of E52 Time Span related via property P4 has time span, and instances of E61 Time Primitive related to E52 via property P82 at some time within. The place of finding is presented in a similar way to the location, through instances of E53 Place related to E7 via property P7 took place at. In this case, the chain is built for the elements modern find spot, modern province, modern region and modern country.

There are some characteristics that describe an epigraphic object that are not explicitly expressed in the CIDOC model such as comments, decoration, metre and paleographic characteristics. The model provides a way around to incorporate this features using property P3 has note and linking to instances of E62 String.

Documental Information CRM entity E31 Document is the way in which the CIDOC CRM model allows the representation of immaterial elements that describe reality. It may be related with any CRM entity via property P70 documents and comprises several forms of expressing those descriptions about reality such as texts, images, graphics, videos, including the special case of documentation databases. This entity is used in EAGLE for representing all the existing information that describes the information carrier objects and the possible inscriptions carried by them, including transcription text, translation text, images and graphics, bibliography, critical apparatus and commentary. Property P70 documents that links E31 document with the carrier object may be classified using property P67.1 has type pointing to an instance of E55 Type. E62 String is used to hold the texts associated to each E31 instance and is related via P3 has note. For the transcription and translation, the language information is stated by property P3.1 has type of P3 linking to an instance of E56 Language. Documents representing the transcription text of an inscription object are identified by a unique URI that differentiate the document within its content provider repository. On the other hand, translation documents may use two different identifiers. The first one corresponds to the URI assigned to the Wikimedia document created for this translation and the second one points to the URI of the document in the content provider repository if there is an independent document there for this translation. Each document identifier is represented by an instance of E41 Appellation and related to E31 using property P1 is identified by. Visual materializations of artefacts as images, drawings or graphics are also represented by E31 Document objects and can be related to either monuments or inscriptions objects. The identification process works in a similar way. In this case the documents have a Wikimedia identifier and an identifier for the content provider side,

both symbolized by instances of E41. Information concerning to the creation of the images is captured through class E63 Beginning of Existence, superclass of E12 Production, that aims to describe actions that bring into existence a new object. This class is related to the document via property P92B brought into existence. The date of creation is registered as before using a combination of E52 Time Span and E61 Time Primitive. The place is stated by an instance of E53 and related via P7 took place at. Intellectual Property Rights information associated to transcription texts, translation texts and image documents is denoted by instances of E30 Right and linked to the respective document by property P104 is subject to. The type of license is specified by instances of E55 Type and related through property P2 has type. Class E39 Actor is designed to model any individual or group of individuals that can be accountable for an action. This class is used here to describe the right holders for each document.

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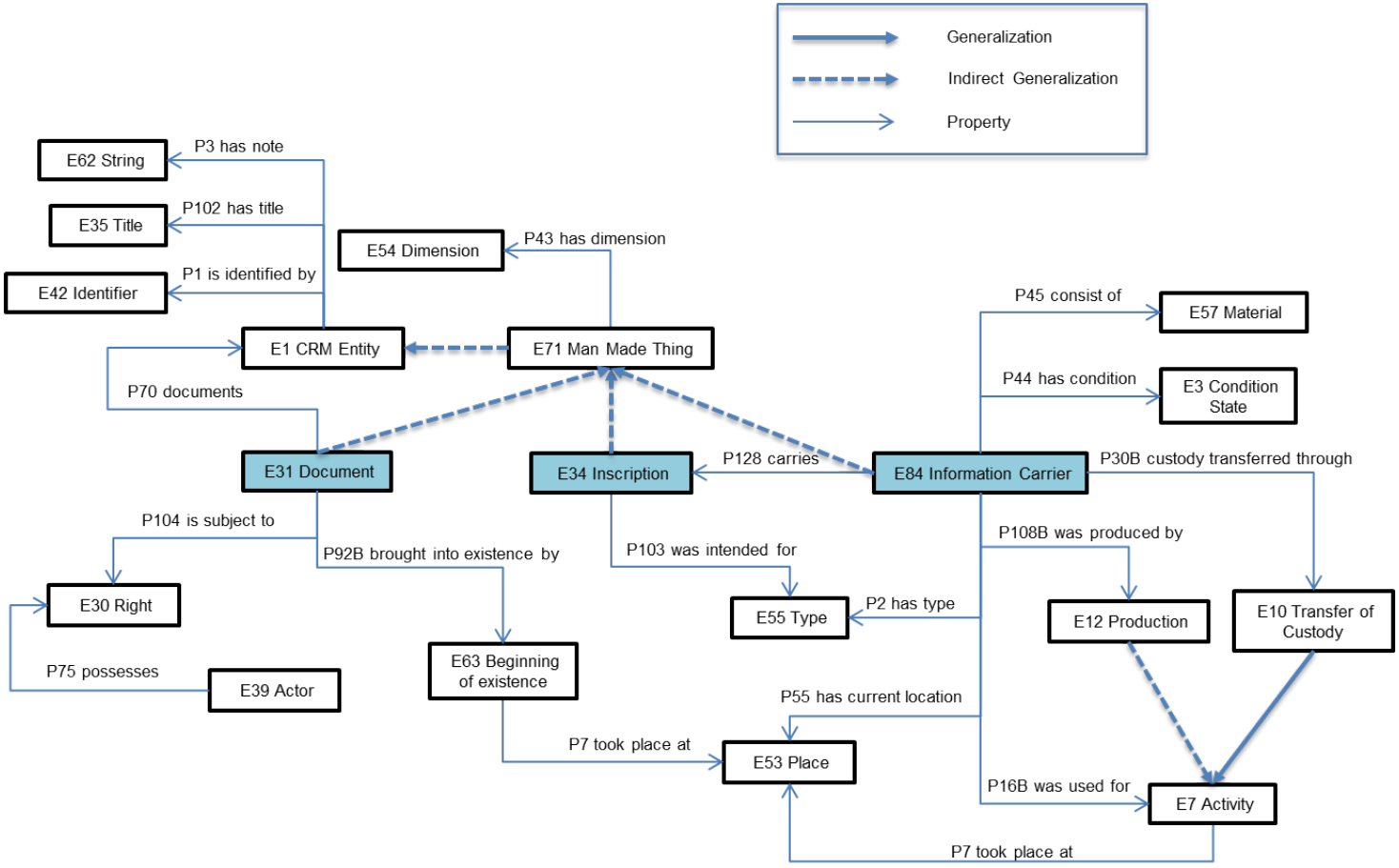

Fig. 2. Low-level Model

5.3 Test and Problems

The implementation of this model was not easy. A first attempt made on an example from EDH (Heidelberg University), led to a basic result which nevertheless made us think about a number of otherwise hidden problems not just in the data model, but in the information we wanted to give. Further discussion with CIDOC experts brought to a new result and highlighted both the potential and the challenges of this mapping, requiring a complete change in perspective on data modeling. This goal is currently under study. Some of the unexpected questions which the CIDOC CRM forced us to think about, are such that one needs to come out of its niche even as a digital epigraphist and push for generalized description in a way that is really unrelated with the specialist or the discipline but can adapt to many at the same one, asking them the same description effort.

Furthermore some ambiguities came up.[24] For example, the year field in a description of a photo is for the EAGLE BPN content providers the year the photo was taken and it is directly related to the author, while in CIDOC this is rightly described as part of the Production Event. In turn this led us to reflect on the definition of the object described: the photo as a physical? or the object photographed? E84_Information_Carrier or E38_Image or E22_Man_Made_Object or one of the possible combinations of these entities? The necessary distinction is a challenging point and it needs not just a technical mapping but a reflection on the meaning and structure of the information. For example, in the above example we actually reflected upon the fact that the Production and Find events did not refer to the same Entity, but to the inscription depicted in the photo in the same way as the current location seems to refer to the Inscription and not to the photo, while the rights refer to the photo as an object.

To solve the find-spot problem, a renowned complexity for this kind of materials, we decided to use a definition from the LAWD vocabulary, lawd:foundAt, which was accepted by that community and makes more sense when describing the object as a whole.

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6 EDM and LOD

One of the aims of the EAGLE project is the publication of the Consortium data in Europeana. An important step in the publication process into Europeana portal is the passage from EAGLE metadata to EDM (Europeana Data Model)[25].

EDM is the metadata model currently used by Europeana for harvesting and publication purposes. It is the Europeana's solution in integrating the existing

[24] Mazurek et al. 2012.

[25] Europeana Data Model documentation; Antoine Isaac, Clayphan, and Haslhofer 2012.

cultural heritage data from a huge amount of content providers, each one of them using their own metadata standards. The content will be enriched by linking to different projects and institutions: data coming from a certain provider may be enhanced by the content from other providers or rich web sources, creating meaningful relations between items and translating the metadata at the same time. EDM is the successor of the Europeana Semantic Elements (ESE)[26] and the result of a joint work with different fields professionals, adopting community standards such as LIDO for museums, EAD for archives and METS for digital libraries. It uses a semantic web based framework that leads the way for the introduction of Europeana in the semantic web, allowing contributors to access to a wide range of Europe's cultural heritage resources. The model encourages independent description for the cultural heritage object and its digital representation, allowing the use of appropriate metadata for each case. The distinction is made by the use of three core classes: edm:ProvidedCHO, edm:WebResource and ore:Aggregation. The edm:ProvidedCHO class is intended for representing cultural heritage objects; the second class, for the description of the possible digital representations of an object and the ore:Aggregation class is the one that states the relation between the others[27]. The EDM is therefore an "ontology the instances of which have to fulfil certain criteria, like being consistent to domain and range restrictions",[28] a graph - RDF structured model that compared to its predecessor is a more expressive model based on ontology. [29]

The Linked Open Data is a way of publishing structured data and allows metadata to be connected and enriched. This kind of data publishing allows to search and find different representations of the same content as well as to link related resources.

The metadata of the object published in Europeana are open since they are under the CC0 licence (Public Domain). Recently, a part of this Europeana data was published as linked data, with the aim to promote more open data. The application of a Linked Data publication strategy in Europeana contributes a large dataset to the community in general, and also gives to the data providers the possibility to implement their own Linked Data publication infrastructure.[30] Moreover, the idea at its base is for the cultural institutions to adopt a linked data paradigm' able to develop a shared semantic context[31] and an enriched data

[26] ESE documentation.

[27] Providers are advised by Europeana to attempt to separate their object's descriptions in order to choose a suitable class for every part. Another benefit on the use of the EDM is that it incorporates contextual resources, permitting providers with their metadata improved by pointing to controlled vocabularies and thesauri, to represent this kind of resources separated from the main object and take advantage of the richness of this data at the same time. Rivero Ruiz, Eydel and Vassallo, Valentina 2013

[28] A. Isaac 2010.

[29] AthenaPlus Deliverable 3.2 - Description of the LIDO to EDM mapping. January 2014.

[30] Haslhofer and Antoine Isaac 2011

[31] Gradmann 2014.

service. This permits to reduce data flows, linking the resources over replicating them and allows third parties to freely take the data and re-use it to create new knowledge and applications.[32]

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7 Conclusions

We have presented in this paper the experience of the EAGLE network, the foreseen and prospected potentials of this and the problem encountered. The structure of current descriptions is radically challenged and precisely questioned by the CIDOC CRM approach, with fruitful results in terms of the clarity of the description itself for researchers and generic users. The efforts for a mapping to CIDOC CRM are worth and necessary for the EAGLE BPN, nevertheless the challenges faced are not minor and need attention and understanding. The EAGLE BPN is convinced of the potential of a multiple exposure and encoding for a richer and more reusable dataset, also because this will allow for implementation and application which will not only benefit the researcher but also the general public or other disciplines in the sector of classical and archeological studies. On the other end, the dialogue between Epigraphists, Digital Humanists, is one among encoders as much as one among researchers and the common aim towards an empowered world of free linked open knowledge will continue to drive the efforts of the Network.

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