

→ **Enhancing the Europeana Data Model (EDM)**

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1. Introduction

The Europeana Data Model (EDM) has been a collaborative effort from the very start. The first requirements were defined by representatives from all the domains represented in Europeana: libraries, museums, archives and audiovisual archives.

EDM has become an interoperable framework for describing digital cultural heritage data. The same collaborative effort now supports extensions and refinements that accommodate the subtleties of cultural heritage domain-specific data. Europeana facilitates this by maintaining EDM as a flexible model and providing adequate documentation to support communities' specific work.

This White Paper gives an account of the latest developments in EDM and highlights the principles that are necessary for the model to continue as a suitable framework for cultural heritage data.

2. The role of EDM in Europeana Services

In five years, the Europeana Data Model has gone from prototype and abstract model to a mature data model that supports the whole Europeana data integration workflow. Europeana now aggregates, processes, enriches and disseminates data using the Europeana Data Model. The model is now a key part of the Europeana platform.

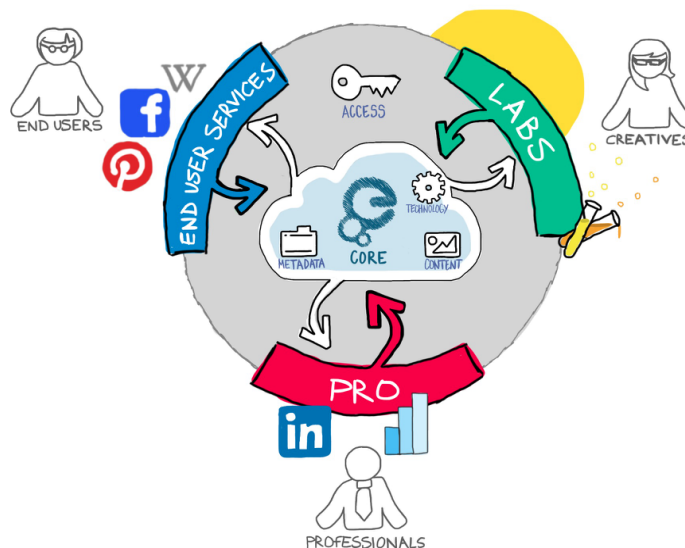


Figure 1: The Europeana Platform from the [Europeana Strategy 2015-2020](#). Visuals by Elco van Staveneren, www.denkschets.nl (CC-BY-SA)



It supports the *Core* of the platform¹ as it is the model used by data providers to describe the data they provide to Europeana. As EDM is built on an open and cross-domain Semantic Web framework rather than a community-specific standard, it can accommodate the range and richness of particular domain standards such as LIDO² for museums, EAD³ for archives or MARC⁴ for libraries. As such, it contributes to the improvement of the overall quality of the Europeana dataset.

EDM allows Europeana to build a network of digital and born-digital cultural heritage objects thanks to the representation of semantic links and relationships between objects. Using EDM, Europeana can, for instance, support complex objects such as those described in archives.

In order to represent the diversity of definitions around hierarchical objects, Europeana and its Network worked on a series of recommendations on how to represent hierarchical objects in EDM (Charles, V. et al. (2013)). This work allowed Europeana to build a display for hierarchical objects in the Europeana portal. This display is built directly on top of the EDM properties supporting sequential and parent-child relationships.

In addition, Europeana has started to build its 'Semantic Layer', a network of contextual information on top of the cultural heritage objects. It includes concepts from 'value vocabularies' like thesauri, authority lists and classifications from Europeana's providers or from third-party data sources. Indeed, the very fact that EDM enables the provision of contextually enriched data encourages data providers to send richer data to Europeana by including links to vocabularies in their data.

Europeana has developed a small enrichment tool in order to 'dereference' vocabulary URIs provided in the data, that is, to fetch all the multilingual and semantic data attached to a given vocabulary concept. This is made easier when the target vocabulary is represented by SKOS⁵, which is also the model EDM re-uses for describing concept data.

In the same way, Europeana performs automatic enrichment with other external value vocabularies and datasets such as GEMET⁶, GeoNames⁷ and DBpedia⁸ by creating links to objects in Europeana (Charles, V, Isaac, A, Freire, N. (2014)).

¹ Europeana Strategy 2015-2020 available at <http://strategy2020.europeana.eu/>

² <http://network.icom.museum/cidoc/working-groups/lido/lido-technical/specification/>

³ <http://www.loc.gov/ead/>

⁴ <http://www.loc.gov/marc/>

⁵ SKOS specifications are available at <http://www.w3.org/TR/skos-reference/>

⁶ <http://www.eionet.europa.eu/gemet/>

⁷ <http://geonames.org>

⁸ <http://dbpedia.org>



De koppelaarster

Description: Litt. : Christopher Braider. Refiguring the real. Picture and modernity in word and image. 1400-1700. Princeton, 1993

Creator: Johannes Vermeer ; http://dbpedia.org/resource/Johannes_Vermeer

Contributor: Johannes Vermeer

Date of creation: 16XX

Auto-generated tags ▾

Who ▾

Agent Term: http://dbpedia.org/resource/Johannes_Vermeer

Agent Label: [jan vermeer] (de) ; [扬·弗美尔] (zh) ; [jan vermeer] (it) ; [johannes vermeer] (pt) ; [jan vermeer] (pl) ; [johannes vermeer] (sv) ; [johannes vermeer] (fr) ; [johannes vermeer] (en) ; [вермеер, ян] (ru) ; [johannes vermeer] (es) ; [johannes vermeer] (nl)

Translate details

Select language ▾

Powered by Microsoft® Translator

informatie bij het Nationaal Gevangenis­museum ; Nationaal Gevangenis­museum ; Nationaal Gevangenis­museum

Source: [107484099], NCRD, Nationaal Gevangenis­museum

Data provider: National Library of the Netherlands - Koninklijke Bibliotheek

Provider: The European Library

Figure 2: Enrichment of the *dc:creator* field with language variants from DBpedia.

EDM allows Europeana to become ‘a big aggregation of digital representations of culture artefacts together with rich contextualization data and embedded in a linked Open Data architecture’ (Gradmann, S. (2010)).

EDM also contributes to the *Access* layer of the platform. EDM data are published via the Europeana API but also as Linked Open Data via data.europeana.eu.⁹ This allows cultural heritage to be re-used by third parties in other applications not necessarily connected to cultural heritage.

Finally, EDM enables the development of new *Services* within Europeana. New portal functionalities can be based on EDM, for example, a hierarchical display which uses relationships expressed in the data. EDM also enables new browsing features for visitors answering ‘Who?’, ‘What?’, ‘When?’, ‘Where?’ questions to contextualize Europeana content.

3. EDM as a living model

3.1. The important contributors to EDM development

The development of EDM wouldn’t have been possible without the support of the data providers and aggregators within the Europeana Network. By raising requirements

⁹<http://labs.europeana.eu/api/linked-open-data/introduction/>



and highlighting the issues encountered with the previous model (Europeana Semantic Elements¹⁰), they helped make the model stronger. More specifically, the technical community, EuropeanaTech,¹¹ contributed to the refinement of the model around some key challenges raised by the community. For instance, the Task Force on Hierarchical Objects made recommendations (Charles, V. et al. (2013)) on how to represent complex objects such as archival documents. The recommendations specified the use of properties defining hierarchical relationships between objects. While the Task Force on Multilingual and Semantic Enrichment (Stiller, Isaac & Petras (eds.) (2014)) conducted an analysis of the controlled vocabularies, collections and metadata fields used and produced for/by enrichment in Europeana. This work is being followed up by a new Task Force aiming to define enrichment frameworks and evaluations methodology for improving automatic enrichment.¹²

In general, EDM can be seen as an anchor to which various finer-grained models can be attached, ensuring their interoperability at a semantic level. For instance, EDM has been aligned to CIDOC-CRM¹³ in its definition of an event-centric model (Isaac, A. (2013)). Further alignment with CIDOC-CRM has been done in the EDM–FRBRoo Application Profile Task Force (EFAP-TF) which defined a mapping of FRBRoo and EDM based on the work of the CIDOC CRM working group (Doerr, M., Gradmann, S., LeBoeuf, P., Aalberg, T., Bailly, R. & Olensky, M. (2013)). These alignments allow the definition of adequate application profiles that enable the transition from one model to another without hindering the interoperability of the data. In a similar way, EDM re-uses properties from the EBUcore model for defining its technical metadata as explained in section 3.4.

Re-using existing vocabularies and defining mappings with existing standards is crucial for EDM to remain a framework that is re-usable by the cultural heritage domain (Charles V, Isaac, A. (2012)). EDM does not require changes in local approaches, but any changes in local practices that increase the cross-domain usefulness of the data are encouraged, such as the use of publicly accessible vocabularies (for people, places, subjects etc.).

¹⁰ <http://pro.europeana.eu/ese-documentation>

¹¹ EuropeanaTech community at <http://pro.europeana.eu/get-involved/europeana-tech>

¹² Task Force on evaluation and enrichment <http://pro.europeana.eu/get-involved/europeana-tech/europeanatech-task-forces/evaluation-and-enrichments>

¹³ <http://www.cidoc-crm.org/>

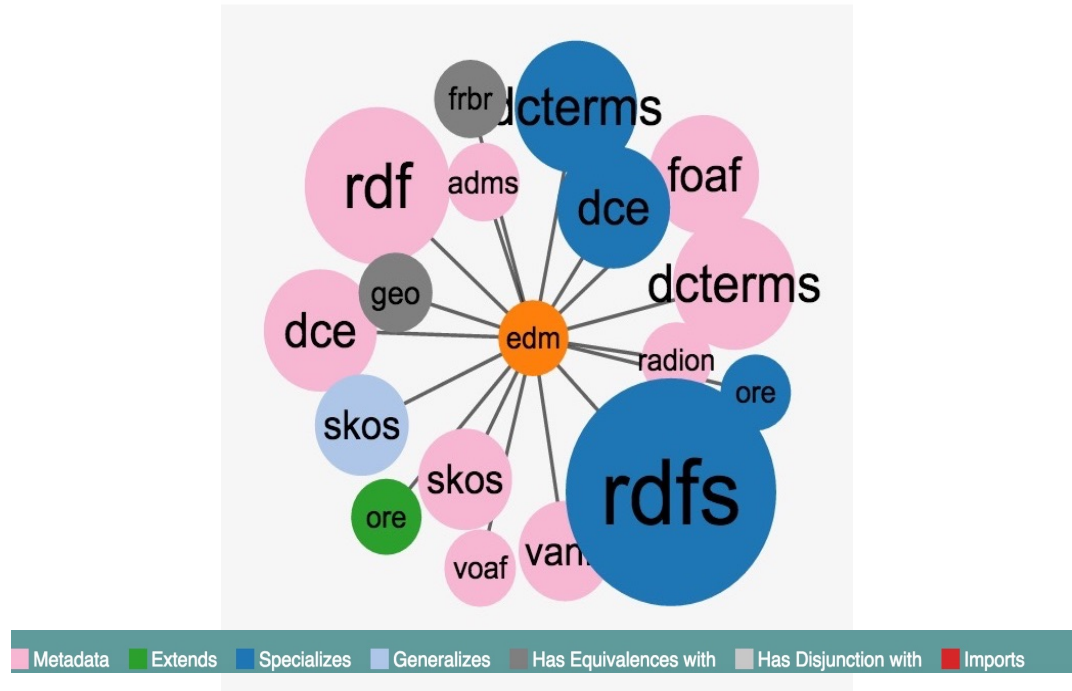


Figure 3: Re-use of different vocabularies in EDM from <http://lov.okfn.org/dataset/lov/vocabs/edm>

EDM is developed to be as re-usable as possible. As EDM is becoming more widely known outside Europeana and its family of projects, other international initiatives have started to use the model in their own applications. The collaboration between Europeana and these institutions is important as it pushes Europeana to develop EDM so it can be re-used by others. Europeana tries to respect the principle of minimal ontological commitment: EDM shouldn't be constrained in a way that would prevent others from re-using it.

The Digital Public Library of America (DPLA),¹⁴ for instance, uses EDM as the core of its model and continues to collaborate with Europeana. Definitions of properties were made more generic to allow their use by the DPLA.¹⁵ The most recent collaboration involves the re-definition of the *edm:rights* property so that it can also be used in the context of the DPLA (DPLA (2015)).

This kind of use of the model generates discussion in groups working on Semantic Web technologies. Europeana is currently involved in a DCMI task group working on RDF Application Profiles and using EDM as a case study.

¹⁴ <http://dp.la/>

¹⁵ The definitions of *edm:country*, *edm:provider* and *edm:dataProvider* were generalised for re-use purposes.



3.2. Maintaining the Europeana Data Model as an open, living standard

Another condition for the re-use of EDM is the way it is maintained by the Europeana Foundation. Sharing vocabularies, the way Europeana does with EDM, we tell the world implies that the model is well- documented and openly shared.¹⁶

Best practices in terms of publication of vocabularies on the web implies dictates that a human-readable as well as machine-readable documentation are is available.

Different documentation is produced for the various profiles of EDM:

- The EDM model as used by the data providers for data delivery. This documentation includes guidance material relating to the data ingestion workflow made public through the Europeana Professional website. (European Data Model (EDM). Version 2.2 (2014)).
- Great effort has been put into making EDM documentation as clear and useful as it can be for the data provider. For this purpose, the 'Data Guidelines' section of the Europeana Professional website was completely reorganised when the new site was launched in February 2015.¹⁷
- The EDM model for data enriched, stored and published by Europeana (containing the results of data enrichment, for instance) in its API or Linked Data service. This documentation is available on Europeana Labs.¹⁸
- Specific EDM profiles supporting domain-specific data or specific functional requirements.

To support different uses of the model, Europeana maintains the EDM schema in a transparent way: it is accessible at any time in its most recent version on Github.¹⁹ Any updates on the schema are systematically documented and made public on the Europeana Professional website.

The Europeana Data Model is maintained in a controlled and transparent environment similar to the way standards are maintained. While being controlled, the development of EDM is done as openly as possible, to facilitate exchange and discussion among the community of experts who work with it. This flexibility gives the assurance that the needs and requirements from cultural heritage institutions are covered.

¹⁶ <http://www.w3.org/TR/dwbp/#dataVocabularies>

¹⁷ <http://pro.europeana.eu/share-your-data/data-guidelines>

¹⁸ <http://labs.europeana.eu/api/linked-open-data/data-structure/>

¹⁹ <https://github.com/europeana/corelib/tree/master/corelib-edm-definitions/src/main/resources/eu>



<p>The <i>EDM Definition</i> is the formal specification of the classes and properties that could be used in Europeana. This overview provides an idea of the frequency of updates of the model. Note that the schema is updated more frequently than the documentation. An update of the main documentation usually covers more than one change at once.</p>	
<p>Version 5.1 was released early in 2010 and comprehensively reviewed and revised through to May 2011 resulting in v5.2.2 as part of Europeana V1.</p>	
<p>Updates contained in version 5.2.3 dated 24/02/2012.</p>	<ul style="list-style-type: none"> - changes resulting from the process of moving from theory to implementation internally e.g. addition of the <i>ProvidedCHO</i> class. - changes needed for ongoing Europeana developments and initiatives e.g. the addition of <i>edm:ugc</i> for projects gathering objects from users. - changes resulting from requirements put forward by other projects e.g. introduction of '3D' as an <i>edm:type</i> for CARARE.
<p>Updates contained in version 5.2.4 dated 14/07/2013.</p>	<ul style="list-style-type: none"> - ongoing amendments and additions as implementation progressed technically e.g. addition of <i>edm:europaProxy</i>, <i>edm:begin</i>, <i>edm:end</i>, <i>edm:preview</i> - amendments to various aspects of properties, such as the definitions or constraints, in response to actual usage. - generalization of property definitions to make EDM usable outside Europeana. For example, the Digital Public Library of America wished to adopt many of our terms but needed the definitions to be less Europeana-specific (Country, DataProvider and Provider). - adjustments recommended by Task Forces, e.g. <i>edm:isNextInSequence</i> made repeatable following the recommendations from the hierarchical objects Task Force. - major editorial changes to rationalise EDM and ESE documentation pending official transition to EDM and deprecation of ESE.
<p>Updates contained in version 5.2.5 dated 22/05/2014.</p>	<p>This is the current version.</p> <ul style="list-style-type: none"> - <i>edm:datasetName</i> property added and <i>collectionName</i> deprecated - <i>dcat:Dataset</i> class added in 'Relevant classes...' section and 'dcat' added as a namespace

Figure 4: Updates made on the EDM Definitions from report D5.2: Up-to-date Guidelines²⁰

²⁰ http://pro.europeana.eu/files//EuropeanaPro/Europeana%20Professional/Projects/Project_list/Europeana_Version2/Deliverables?preview=Ev2+D5.2+Updated+EDM+documentation.pdf



3.3. The role of EDM in the context of the Semantic Web

EDM is the foundation for Europeana's Linked Open Data vision for data services. The model now encourages providers to send richer and networked metadata. The support for contextual resources, for instance, encourages providers to send URIs from linked open vocabularies that will allow Europeana to publish richer data.

EDM has also been identified as a suitable model for publishing Linked Open Data. The European Library, for instance, has based its Linked Data model on EDM.²¹

Another interesting aspect is the use of EDM as teaching material for information management professionals. The University of Nevada, Las Vegas, for instance, has chosen EDM to train its academic library staff²² in Linked Data.

The advantages of EDM for training Linked Data are:

- the presence of substantial documentation about the model and the existence of many use cases
- the use of existing standards in EDM such as Dublin Core and Friend Of A Friend (FOAF), making EDM an introduction to these other standards
- the introduction of other concepts relevant to Semantic Web technologies such as data mapping, URI assignment and controlled vocabularies.

EDM is a flexible model that can be extended to cover more specific data requirements (as detailed in in section 3). The adoption of EDM by more data providers also supports the increased production of mappings, application profiles and extensions of EDM. These different types of interoperability patterns lead to the creation of various types of rules, including cardinality constraints and functional requirements as well as some more general data quality rules. More generally, they allow the production of different data 'flavours' that need to be managed. The rules behind these flavours can be very complex and their correct interpretation and implementation can be a challenge. It is therefore crucial that they are appropriately documented in order to be readable and interpretable both by humans and machines. The definition of those rules in machine-readable formats is also a condition for the distribution and re-use of metadata as Linked Data, since it provides a way to validate the data against specific requirements.

Europeana is currently working with the DCMI RDF Application Profiles Task Group (RDF-AP)²³ to develop a set of recommendations regarding the proper creation of data models, in particular the proper re-use of existing data vocabularies based on use cases such as the Europeana Data Model. In the context of web technology, RDF is the first candidate the group is looking at. It is a natural candidate for formalizing

²¹<http://www.theeuropeanlibrary.org/tel4/access/data/opendata>

²²<http://pro.europeana.eu/learningcontext-edm/>

²³http://wiki.dublincore.org/index.php/RDF_Application_Profiles/



rules to enable the validity of the data, provide further provenance and more importantly, to facilitate the sharing and re-use of metadata schemas.

4. Evolution and model refinements for EDM

EDM is not a static model. As Europeana develops new data features, it refines and extends its model to accommodate new requirements. These extensions of the model allow Europeana to describe metadata at various levels of granularity (Charles, V. & Olensky, M. (2014)).

Europeana refines its model in two ways:

- It creates new sets of guidelines or rules applicable to existing classes and properties to specify their use in a given context. This means that the property or class being refined will be used in a narrower, but still compatible, sense than existing properties. Such a set of guidelines is also called an Application Profile.
- It creates extensions to EDM by adding new classes and properties to the original EDM specifications. The new element sets are declared as specializations of the more generic properties. The specialization of EDM classes and properties is done by using constructs from RDFS Schema:
 - *rdfs:subClassOf* to state that all the instances of one class are instances of a more general one
 - *rdfs:subPropertyOf* to state that all resources related by one property are also related by a more general one.



This principle of specialization, as shown in Figure 4, allows the co-existence of a generic level (the EDM classes and properties) and a specific level (DM2E classes in the example below). In Figure 4, *dm2e:writer* is a specialization of the more generic property *dc:creator*.

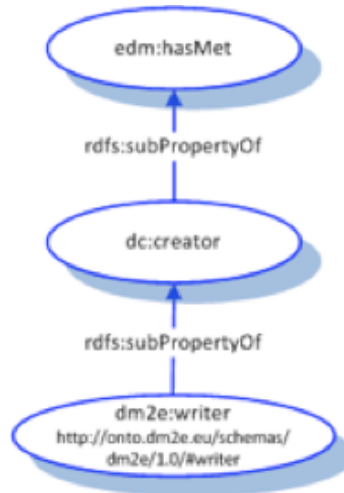


Figure 4: Principle of ontology specialization based on the RDFS properties. This figure is based on some properties available in the Europeana Data Model.

Europeana attempts to limit the complexity of EDM by offering two levels of formalization:

- a generic level that provides simple semantics
- a specific level in which properties and classes have been specialized.

These two levels allow the re-use of EDM by different audiences and enable complex tasks such as reasoning as well as simpler operations.

In addition, EDM re-uses existing vocabularies from the community as much as possible in order to increase interoperability and to reduce redundancy with existing vocabularies, as described in section 2.1.

The following sections are examples of specialization and extensions created by Europeana. Each extension has a table detailing the motivation or the requirements behind its creation and the vocabularies re-used in EDM to support these requirements. Further details on the classes and properties and how they are defined in EDM can be found at

<https://github.com/europeana/corelib/wiki/EDMObjectTemplatesProviders>.

4.1. Profiles for representing datasets and organizations

In addition to managing data about cultural heritage objects, Europeana also needs to manage information about organizations and the datasets sent by these



organizations. Europeana created two extensions to support information about these two entities in a controlled way.

Organization profile

Motivation	<p>An organization in EDM is structured around three classes:</p> <ul style="list-style-type: none">• An Organization is represented as a <i>foaf:Organization</i> class (a subclass of <i>edm:Agent</i>) and has a 'hasAddress' property with the range of an 'Address' class, which contains all the details of the postal address. An Organization also has 'mainContact' and 'technicalContact' properties with the range of a 'Person' class (sub-property of <i>edm:Agent</i>)• A Person will be represented as a <i>foaf:Person</i> class (a subclass of <i>edm:Agent</i>) and will have a 'hasAddress' property with the range of an 'Address' class, which contains all details of the postal address.• An Address will be represented using <i>vcard:hasAddress</i> syntax (EDM organization profile (2014))
Vocabularies re-used	<p>Friend-Of-A-Friend (FOAF) http://xmlns.com/foaf/0.1/ vCard http://www.w3.org/2006/vcard/ns# Creation of additional properties in the EDM namespace such as <i>edm:organizationSector</i>.</p>

Dataset profile

Motivation	<p>The dataset profile defines the elements that will be used to represent a dataset ingested by Europeana (EDM dataset profile (2014)). In the context of Europeana, a dataset is a collection of data from a given organization. A Europeana dataset can be about a certain topic, originate from a certain source or process and is aggregated by a certain custodian.</p>
Vocabularies re-used	<p>Data Catalog Vocabulary (DCAT) http://www.w3.org/TR/vocab-dcat/ Asset Description Metadata Schema (ADMS) http://www.w3.org/ns/adms#/</p>

The organization and dataset profiles are currently used in the Europeana API for information on providers and datasets.²⁴ API users can retrieve information about the institutions and datasets currently represented in Europeana. The profiles have, however, not been made available to data providers.

²⁴ <http://labs.europeana.eu/api/provider/>



4.2. Profile for representing collections

In the aggregation model used to submit data to Europeana, the totality of a curated collection submitted by a data provider may be difficult to find in the large and diverse Europeana dataset.

A collection profile has been defined to enable the description of collections in the context of EDM (EDM collection profile (2014)). It will allow data providers to supply curated descriptions of the identifiable collections they have submitted to Europeana, which has great potential use for audiences, as shown by Wickett et al. 'Collection structures provide the organizational and intellectual context important to researchers, and collection descriptions provide information needed by users for interpreting the relevance and significance of individual items for their purposes' (Wickett, K.M., Isaac, A., Fenlon, K., Doerr, M., Meghini, C., Palmer, C.L & Jett, J. (2013)).

Europeana does not currently implement this profile but use cases are being collected from data providers (such as the archeology domain) or from other communities such as researchers in the context of Europeana Research.²⁵

Motivation	A collection in the context of Europeana is a group of objects gathered together for some intellectual, artistic or curatorial purpose. In the context of this profile, the Collection class represents the original collection of cultural heritage objects (probably physical objects, but also born- digital where appropriate).
Vocabularies re-used	Additional EDM classes and properties were created such as the main <i>edm:Collection</i> class. http://www.w3.org/TR/vocab-dcat/ Dublin Core Collection Description Terms http://purl.org/cld/terms/

4.3. Profile for representing technical metadata

Europeana is currently defining its Europeana Publishing Framework to promote the re-use of the digital representations provided as part of the delivered metadata (EDM profile for technical metadata (2015)). In order to facilitate re-use, Europeana builds facets and filters based on the technical metadata of these digital representations (described in EDM by the class *edm:WebResource*). EDM was extended to fit the five media types currently supported by Europeana, namely: Sound, Video, Text, Image and 3D objects.

²⁵<http://research.europeana.eu/>



Motivation	This profile lists the properties that will apply to the WebResource class and an additional class that were defined to support such functionality.
Vocabularies re-used	EBUcore http://www.ebu.ch/metadata/ontologies/ebucore/

4.4. Extensions for complex rights

The new developments around the Content Re-Use Framework provide new requirements for representing rights statements for digital representations of cultural heritage objects²⁶. Europeana needs a way to structure rights information for different types of resources.

This extension of EDM focuses on the creation of 'complex' values for the existing property *edm:rights*. The indication of an identifier of a rights statement (e.g. CC-BY) in a unique field (*edm:rights* on the EDM *ore:Aggregation* resource) no longer covers more complex requirements. This profile envisions that different access and re-use conditions can be provided for different views of a cultural object. It therefore allows the representation of individual views with specific rights statements.

An additional requirement came as the result of public-private partnerships that require the specifications of contractual restrictions. For this given type of licence, Europeana needed a new property for storing the end date of a copyright claim, licence or other type of restriction on re-use as expressed in the *edm:rights* field of the metadata records.

Motivation	The profile introduces a new <i>cc:Licence</i> class to which additional properties are added such as <i>cc:deprecatedOn</i> to declare an expiration date.
Vocabularies re-used	Creative Commons Rights Expression Language (ccREL) http://creativecommons.org/ns# ODRL http://www.w3.org/ns/odrl/2/

Europeana continues its work on representing complex rights as part of a collaboration with the Digital Public Library of America (DPLA) to build a common technical infrastructure for rights statements and an extensible framework to host the rights statements at rightsstatements.org. This work requires the definition of new

²⁶<http://pro.europeana.eu/blogpost/extending-the-europeana-licensing-framework>



classes and properties to express data for the statements that may be propagated into the EDM specifications.²⁷

4.5. Future work

The Europeana Strategy for 2015-2020 lists plans to further develop EDM. One important item is the development of new services for end-users to improve their engagement with cultural heritage data. Crowdsourcing is one way of involving people and Europeana is currently looking at implementing it for annotations.

EDM will be extended based on recommendations from the Web Annotation Data Model.²⁸ This extension will allow the support of scenarios such as semantic tagging or crowdsourced metadata enrichment.

5. Re-use and extensions of the EDM model

The Europeana Data Model is not only used internally by Europeana to describe cultural heritage objects, it is also re-used in the broader cultural heritage domain.

In some cases, EDM as defined by Europeana's specifications, cannot represent the semantics of providers' metadata with sufficient detail. Those details matter even more when EDM is re-used in a domain-specific context.

Data providers need to represent their metadata at different levels of granularity. Cultural heritage institutions are therefore developing extensions to meet their own needs.

It is important to note that the elements in these extensions can almost always be mapped to a more generic property in EDM, following the specialization principle mentioned in Section 3 (Fig.4). This mechanism allows metadata described for specific applications to remain interoperable with more generic applications such as the main Europeana.eu portal.

The extensions of EDM are for the most part based on existing vocabularies but in some cases the institution or project have decided to create their own properties and have therefore declared a new namespace for them.

The development of such extensions is beneficial to Europeana. It allows the identification of new domain-specific requirements that can be implemented in Europeana's own service without hindering the interoperability between data services. The development of the model itself remains a collaborative effort.

²⁷ <http://pro.europeana.eu/blogpost/developing-and-implementing-a-technical-framework-for-interopera>

²⁸ <http://www.w3.org/TR/annotation-model/>



The examples below present some of the extensions that have been developed within Europeana affiliated projects and organizations (5.1), but also by institutions outside Europeana's direct Network (5.2).

5.1. EDM extensions in the Europeana Network

Europeana-affiliated projects have started to re-use EDM in their applications rapidly. The Europeana Fashion project (Vanstappen, H. (2012)), the German Digital Library²⁹ (DDB) and the Polymath Virtual Library³⁰ have built their data modelling on EDM and integrated new elements or elements from other metadata standards for addressing their specific needs.

Below are two extensions addressing the needs of different communities but also supporting different types of requirements.

DM2E specialization of EDM for manuscripts

The Digitised Manuscripts to Europeana (DM2E) model allows the description of rich metadata for manuscripts, answering the needs of scholars without hindering interoperability with Europeana as the DM2E model is built on top of the Europeana one (DM2E (2014)). As for other domains, data from the manuscripts domain aggregated by DM2E are represented by various schemas (e.g. TEI, METS/MODS, MARC21 or provider-specific schema) that describe the data at a different level of granularity than EDM. DM2E have therefore created specializations of EDM for:

- supporting the description of manuscript-specific information (for instance, the DM2E model introduces the property *dm2e:incipit*, which is used for representing the opening words of a manuscript)
- describing more granular information for certain types of entities (for instance, different types of creators such as writer or author)
- representing provenance information
- supporting different levels of description (such as objects or parts of an object like a book, a manuscript or a page)
- representing annotable resources such as images like PNG or JPEG, or text.

The DM2E model re-uses the following namespaces (many of which are 'inherited' from EDM):

bibo	http://purl.org/ontology/bibo/
crm	http://www.cidoc-crm.org/cidoc-crm/
dc	http://purl.org/dc/elements/1.1/

²⁹ <http://dcevents.dublincore.org/IntConf/dc-2014/paper/download/231/300>

³⁰ <http://pro.europeana.eu/share-your-data/data-guidelines/edm-case-studies/polymath-edm>



dcterms	http://purl.org/dc/terms/
edm	http://www.europeana.eu/schemas/edm/
fabio	http://purl.org/spar/fabio/
foaf	http://xmlns.com/foaf/0.1/
ore	http://www.openarchives.org/ore/terms/
pro	http://purl.org/spar/pro/
rdaGr2	http://rdvocab.info/ElementsGr2/

EDM profile for Sound

A Task Force as part of the Europeana Sounds project developed an EDM profile for supporting characteristics of sound objects and the metadata describing them (Charles, V. et al. (2015)). The Task Force identified the specificities of sound object metadata and analysed the needs that could be met using EDM.

The extensions have been taken from existing open data models, namely EBUCore, the Music Ontology³¹ and Dublin Core. These new properties have been declared as specializations of the existing ones.

The EDM profile for Sound supports the following requirements:

- Distinction of the master version among the digital representations available for a cultural heritage object (CHO)
- Duration in sound CHOs and WebResources
- Track information for sound CHOs and WebResources
- Hierarchical relationships and collections.

5.2. EDM extensions outside the Europeana Network

EDM has also been extended and re-used outside of Europeana's direct Network.

The Smithsonian American Art Museum (SAAM) uses an extension of EDM to publish data on the web (Szekely, P., Knoblock, C., Yang, F., Zhu, X., Fink, E., Allen, R., & Goodlander, G. (2013)). EDM was adopted by them as a way to maximize interoperability with existing museum Linked Open Datasets.

In the same way, the Linking History project uses EDM to model data from a research project in which students linked people and place names from Australia's capital city,

³¹<http://musicontology.com/>



Canberra, to cultural heritage objects. EDM was also chosen as a way to generate Linked Data for this project.

Lastly, EDM is used as a foundation for the data model used by the Digital Public Library of America. The current version re-uses EDM-specific classes and properties as well as definitions from the following sources:

- Resource Description Framework (RDF) and the RDF Schema (RDFS)
- OAI Object Reuse and Exchange (ORE)
- Dublin Core namespaces (dc elements, dcterms, and dcmitype)
- The Basic Geo (WGS84 lat/long) Vocabulary

6. Conclusion

Five years ago, Europeana's first White Paper, by Prof. Stefan Gradmann, advocated the design of an advanced data model, re-using existing pieces of web technology (Gradmann, S. (2010)). The Europeana Data Model has now become a reality that we, our data partners and data re-users can work with.

Since its original release, EDM has been implemented throughout the infrastructure and entire portfolio of Europeana services: we now ingest, store, enrich and exchange data following a richer, more semantic approach. In the process, EDM has been updated or 'profiled' to enable new functions, such as representing hierarchical objects. This work continues, for example, as Europeana prepares to handle more data enrichment, including user annotations.

The ongoing maintenance of EDM is an open process. EDM would not exist without the contributions of our data and academic partners. In the past few years, Task Forces within the EuropeanaTech community have played a crucial role, for example, looking at hierarchical objects, sounds, and compliance with other modelling approaches like FRBR.

The Europeana Foundation does its best to keep the model well-documented and flexible. EDM is built for re-use and itself re-uses existing elements from well-established vocabularies as much as possible.

In true linked data fashion, EDM 'profiles' can be developed without Europeana having to update the core model. Elements can be attached to the model without a corresponding implementation in Europeana's core platform.

This flexible approach has made it easier to extend EDM to meet the data needs of specific domain aggregators like Europeana Sounds,³² and address the requirements of new data services and enrichment in Europeana's main platform. EDM is now used by Europeana and several other cultural aggregators, such as DPLA and DDB.

³²<http://www.europeanasounds.eu/>



More extensions and profiles are foreseen in the future. One challenge then will be how to handle the resulting diversity of profiles in a seamless way. Exploiting the data expressed with these profiles across different systems still requires work. But thanks to the basic principles underpinning EDM, it is now possible to realize the vision in which the design of data models is decentralized and tailored to specific applications, while the data created and exchanged with them still forms a vast, semantically interoperable knowledge environment.

7. References

Charles, V. et al. (2013). Recommendations for the representation of hierarchical objects in Europeana. Retrieved May 25, 2015 from <http://pro.europeana.eu/documents/468623/4a6eb2ec-4cc6-48b1-8824-92a1e564a279>

Charles, V. et al. (2015). EDM profile for Sound. Retrieved May 25, 2015 from http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/EDMSound//TF_Report_EDM_Profile_Sound_301214.pdf

Charles, V. & Olensky, M. (2014). Report on Task force on EDM mappings, refinements and extensions. Retrieved May 25, 2015 from http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/Mapping_Refinement_Extension//EDM%20%20Mapping%20refinement%20extension%20Report.pdf

Charles, V, Isaac, A, Freire, N. (2014). Linking Libraries in The European Library and Europeana. [IFLA 2014 Satellite Meeting Linked Data in Libraries](#).

Charles V, Isaac, A. (2012). Europeana and (many) linked open vocabularies. [LOV Symposium: Linking and Opening Vocabularies](#), Universidad Carlos III de Madrid, Spain, June 18, 2012. [Slides](#)

DM2E (2014). DM2E Model V 1.2 Specification http://dm2e.eu/files/DM2E_Model_V1.2.pdf

Doerr, M., Gradmann, S., LeBoeuf, P., Aalberg, T., Bailly, R. & Olensky, M. (2013). Final Report on EDM – FRBRoo Application Profile Task Force. Retrieved May 25, 2015 from http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/EDM_FRBRoo//TaskfoApplication%20Profile%20EDM-FRBRoo.pdf

DPLA (2015) <http://dp.la/info/developers/map>



European Data Model (EDM).Version 2.2 (2014)

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_Documentation/EDM_Mapping_Guidelines_v2.2.pdf

EDM collection profile (2014). Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_profiles/EDM%20Collection%20Profile.doc

EDM dataset profile (2014). Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_profiles/Dataset%20profile.pdf

EDM organization profile (2014). Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_profiles/Organisation%20profile.pdf

EDM profile for technical metadata (2015). Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_profiles/Technical%20Metadata%20Properties_20150217.docx

Gradmann, S. (2010). Knowledge = Information in Context: on the Importance of Semantic Contextualisation in Europeana. Retrieved from

<http://pro.europeana.eu/publication/knowledgeinformation-in-context>

Isaac, A. (2013). Europeana Data Model Primer. Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/Share_your_data/Technical_requirements/EDM_Documentation/EDM_Primer_130714.pdf

Stiller, Isaac & Petras (eds.) (2014): EuropeanaTech Task Force on a Multilingual and Semantic Enrichment Strategy: final report. Available:

http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/MultilingualSemanticEnrichment//Multilingual%20Semantic%20Enrichment%20report.pdf

Szekely, P., Knoblock, C., Yang, F., Zhu, X., Fink, E., Allen, R., & Goodlander, G. (2013). Connecting the Smithsonian American Art Museum to the Linked Data Cloud. In P. Cimiano, O. Corcho, V. Presutti, L. Hollink, & S. Rudolph (Eds.), *Lecture Notes in Computer Science. The Semantic Web: Semantics and Big Data* (pp. 593–607). Berlin, Heidelberg: Springer.

Vanstappen, H. (2012). Europeana Data Model – Fashion Profile (EDM-fp). Retrieved May 25, 2015 from

http://pro.europeana.eu/files/Europeana_Professional/EuropeanaTech/EuropeanaTech_taskforces/Mapping_Refinement_Extension/Case_studies/EuropeanaFashion/EDM-FP%20specification.docx



Wickett, K.M., Isaac, A., Fenlon, K., Doerr, M., Meghini, C., Palmer, C.L & Jett, J. (2013). Modeling cultural collections for digital aggregation and exchange environments. Retrieved May 25, 2015 from <http://hdl.handle.net/2142/45860>