

Europeana Data Model: The Key to Cooperation with Europeana

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ABSTRACT: Europeana Data Model (EDM) is a comprehensive data model created with the idea of presenting versatile digital objects within a single metadata schema to ensure interoperability. It is based on the principle of linked open data and the semantic web. The paper deals with the application of this model in the National Library of Serbia through direct cooperation with Europeana, within which the library performs the role of a national aggregator for Europeana, as well as a data provider.

KEYWORDS: EDM, digital library, Europeana, metadata, metadata aggregator.

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1 Introduction

Europeana is the most important initiative and the greatest investment of the European Commission into the digitisation of cultural heritage. It was founded in 2008 to transform the world with culture and strengthen the European identity among its citizens through common cultural heritage in the digital form. The core of Europeana is its platform,¹ which provides access to over 51 million digital objects from more than 3,500 libraries, museums, archives and galleries across Europe (March 2022). The Europeana Initiative is an ecosystem consisting of three interconnected expert organisations: Europeana Foundation, Europeana Aggregators' Forum and Europeana Network Association. The Europeana Foundation, seated at the Royal Library of the Netherlands, is an independent, non-profit organisation with around 60 employees engaged in the development of the Europeana platform and

1. Europeana, „Welcome to Europeana“

cooperation with other cultural heritage digitisation initiatives. The Europeana Aggregators' Forum consists of 40 accredited metadata aggregators, out of which 13 are domain and thematic and 27 are national and regional. The Europeana Network Association is an open and democratic community of experts involved in the digitisation of cultural heritage. It boasts over 3,000 experts from cultural heritage institutions, the IT sector and educational and research institutions. The Europeana mission statement says: "Europeana empowers the cultural heritage sector in its digital transformation. We develop expertise, tools and policies to embrace digital change and encourage partnerships that foster innovation. We make it easier for people to use cultural heritage for education, research, creation and recreation. Our work contributes to an open, knowledgeable and creative society." The Europeana vision statement says: "Europeana imagines a cultural heritage sector powered by digital and a Europe powered by culture, giving it a resilient, growing economy, increased employment, improved well-being and a sense of European identity."

Since Europeana was not envisioned as a repository of digital content, but rather as an aggregator of its metadata, the Europeana Data Model (EDM) – the metadata schema on which the database in its background is based – is the backbone of its platform. The EDM enables the interoperability of metadata originating from different institutions and is the least common denominator for all metadata schemas used by different cultural institutions to describe their digital objects, such as METS in libraries, LIDO in museums or EAD in archives.

Since Europeana's foundation, the National Library of Serbia (Narodna biblioteka Srbije – NBS) has been cooperating with it as a metadata provider. Initially, the aggregation was performed through The European Library (TEL), which acted as an aggregator for all the European national libraries until its closure in December 2016. In 2015, the NBS began working on establishing the national aggregator. The same year, the Data Exchange Agreement (DEA) was signed between the library and Europeana. The aggregation infrastructure (Aggregator for Europeana) was developed in partnership with the Slovenian company Semantika (Butigan-Vučaj 2019). The Aggregator, which is housed at the Digitisation Department of the National Library of Serbia, has been operational since 2018. That year, the National Library of Serbia became part of the Europeana Aggregators' Forum, having previously fulfilled all the necessary conditions to obtain the status of an accredited aggregator and a trusted partner of Europeana. The Aggregator for Europeana has been recognised as a provider of quality metadata, and it

has also achieved admirable standards in terms of content description, metadata mapping, copyright licence attribution for digital objects, accessibility, multilingualism and the use of controlled vocabularies. It has also become a source of information, guidance and support in the digitisation process. In addition to all this, the Aggregator for Europeana is the only aggregator operating from a non-EU country. So far, the NBS has submitted datasets in the EDM format in preparation for their publication on the Europeana platform as part of the following European projects: Europeana Collections 1914-1918, Collections of South and East Europe in Europeana (CSEEE), The Rise of Literacy, Migration in the Arts and Sciences and Europeana Common Culture. The European Library was the metadata aggregator for the first two projects, whereas the NBS Aggregator for Europeana was already operational during the remaining three projects. The Europeana Common Culture project,² which involved 23 aggregators from 21 European countries, was vital for metadata standardisation and the improvement of the entire aggregation infrastructure. As part of it, the NBS maximised the quality of its metadata for all the datasets that had been published on Europeana up to that point.

2 Europeana Data Model (EDM)

Europeana provides access to versatile materials coming from different cultural heritage institutions across Europe. Those institutions rely on different metadata standards, which mainly depend on the type of material. All those resources are extremely important. However, the diversity of data formats, as well as the efforts to preserve as much information as possible, with as little data overlap, gave rise to a need to establish a common metadata standard, which would be easily applicable to the materials stored in libraries, museums, archives and institutions in possession of audio-visual collections. As a result, it was decided to introduce a common metadata model – one that would enable data linking to facilitate search based on certain criteria.

Europeana Semantic Elements³ (ESE) was the early stage in the development of this idea. Its further elaboration led to the establishment of the Europeana Data Model⁴ (EDM) (Drege 2019; Klimpel and Ojler 2019).

2. Europeana, “Europeana Common Culture”, accessed 18. 3. 2022

3. Europeana, „Europeana Semantic Elements Documentation“, accessed 17. 3. 2022

4. Europeana, „Europeana Data Model“, accessed 17. 3. 2022

EDM⁵ constitutes an improvement of the previous model in that it enables the integration of semantic elements and descriptions of hierarchical structures. Also, metadata can now be connected with the digital reproductions of the material they relate to. Besides, EDM offers the possibility of free text entry to ensure the highest content description quality possible. EDM also enables the entry of values that relate only to the digital copies in addition to those that relate to the physical objects.

As EDM combines materials from different cultural institutions, it is a much better overall solution compared to individual standards compatible with specific types of material. When converting metadata into EDM, there is no data loss. EDM is based on an open framework enabling participation in the semantic web. Thanks to it, the data related to persons, space and subject areas can be connected regardless of their provenance. This stimulates mutual data enrichment between institutions and facilitates the discovery of new resources from the perspective of users interested in a determined topic, which, in turn, leads to an increase in the traffic to cultural heritage objects kept at different institutions.

The EDM format is based on the following standards: OAI ORE (Open Archives Initiative Object Reuse & Exchange),⁶ SKOS (Simple Knowledge Organization System),⁷ DC (Dublin Core)⁸ and CIDOC-CRM.⁹ Furthermore, it also relies on various normative databases and dictionaries. That way, new connections between objects are established and language barriers are overcome. Through EDM, data is collected, linked and enriched. Since it is based on open data and the semantic web, cultural heritage from institutions which cooperate with Europeana can reach a wider audience. The semantic web provides a broader metadata context and enables the representation of complex relationships between different objects as well as different parts of an object while encouraging data reuse and reliance on external resources available as related data. The principles of the semantic web have been implemented in the form of the RDF¹⁰ (Resource Description Framework) standard.

5. Europeana, „Europeana Data Model – Mapping Guidelines v2.4“, accessed 17. 3. 2022

6. „Open Archive Initiative - Object Exchange and Reuse“

7. „SKOS Simple Knowledge System Namespace Document“

8. „DCMI Metadata Terms“

9. „Classes & Properties Declarations of CIDOC-CRM“

10. World WideWeb Consortium „RDF Primer“

EDM consists of three main classes. They represent three different parts of a single record. The `<edm:ProvidedCHO>` class refers to a physical object. It contains the data about the author(s), publisher, year of publication, format, publication language, unique object identifier and, also, geographic and temporal headings. The `<ore:Aggregation>` class contains data on the object, the institution where the object is kept and the institution which delivered the data to Europeana. This class also contains links to the digitised object and the attributed licence, which serves to let the users know how the digitised material can be used. The `<edm:WebResource>` class refers to the digital reproduction of the object. In addition to those three main classes, some other classes can be included in a record to represent entities that are somehow related to the object: `<edm:Agent>`, `<edm:Place>`, `<edm:TimeSpan>`, `<skos:Concept>`, etc. The classes contain properties with descriptive elements. The classes and their properties are defined based on RDFS (Resource Description Framework Schema)¹¹ and OWL (Web Ontology Language)¹² elements.

The National Library of Serbia uses the COMARC/B metadata standard (Figure 1) within the COBISS platform for the metadata related to the materials published on its digital presentation (Digitalna NBS). For data delivery to Europeana, the data is exported from COBISS and converted into the EDM format using various internal tools for data verification, enrichment, refinement and conversion. They facilitate data transfer from the relevant fields of a comarc.xml record to the required fields within an EDM record. Then, the obtained EDM record is uploaded to the Aggregator for Europeana, which performs a further transformation, after which the record is ready to be harvested by Europeana and published on the platform.

The `<ore:aggregates>` element contains all the data related to a digitised object (a book, an issue of a periodical or a photograph). The `<edm:ProvidedCHO>` class contains the link toward the digital object at Digitalna NBS¹³ (Europeana does not store the digitised material from cultural heritage institutions. Instead, it presents the metadata and directs the users to the websites of those institutions via links). The `<dc:creator>` property relates to the author(s). Since the integration of the normative database of authors' names (CONOR)¹⁴ into the COBISS system, two `<dc:creator>` properties have been introduced into EDM (Cyrillic and Latin; also, the

11. „RDF Schema 1.1“

12. „owl:Ontology“

13. National library of Serbia, “Digitalna NBS”

14. Izum, “CONOR normative database”

```

<core:aggregation>
  <edm:providedCHO rdf:about="http://www.digitalna.nb.rs/wb/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85">
    <dc:contributor xml:lang="sr">Jovan Popovic (1905-1952)</dc:contributor>
    <dc:contributor xml:lang="sr">Jovan Bonomoh (1905-1952)</dc:contributor>
    <dc:contributor rdf:resource="http://www.wikidata.org/wiki/Q6926683" xml:lang="sr"/>
    <dc:creator xml:lang="sr">Borde Andrejević-Kun (1904-1964)</dc:creator>
    <dc:creator rdf:resource="http://www.wikidata.org/wiki/Q1833247" xml:lang="sr"/>
    <dc:description xml:lang="sr">Tiraž 250.</dc:description>
    <dc:format xml:lang="sr">Str. 1-11: Umjetnik i njegovo delo / J. Popović.</dc:description>
    <dc:format xml:lang="sr">32 str., 28 listova s tablicama</dc:format>
    <dc:format xml:lang="sr">drvoresni, crno-belo</dc:format>
    <dc:format xml:lang="sr">25 cm</dc:format>
    <dc:identifier="19191516"><dc:identifier>
    <dc:language="sr"></dc:language>
    <dc:publisher xml:lang="sr">D. Andrejević-Kun</dc:publisher>
    <dc:subject xml:lang="sr">Poplje Anđeljević-Kun</dc:subject>
    <dc:subject xml:lang="sr">Muzijevski nacrti</dc:subject>
    <dc:subject xml:lang="en">Industrial Heritage</dc:subject>
    <dc:title xml:lang="sr">Krvaso plato : 28 originalnih drvoresa B. Andrejevića-Kuna</dc:title>
    <dc:terms:issued="1937"></dc:terms:issued>
    <edm:currentLocation rdf:resource="http://www.gsonames.org/792680"/>
    <dc:type="TEXT"></dc:type>
    <dc:type xml:lang="sr">našara</dc:type>
  </edm:providedCHO>
  <core:aggregation rdf:about="http://www.digitalna.nb.rs/wb/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85">
    <edm:aggregationID rdf:resource="http://www.digitalna.nb.rs/wb/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85"/>
    <edm:provider="National Library of Serbia"></edm:provider>
    <edm:dataProvider="National Library of Serbia"></edm:dataProvider>
    <dc:rights rdf:resource="http://creativecommons.org/licenses/by-nc-sa/4.0/">
    <edm:isShownAt rdf:resource="http://www.digitalna.nb.rs/wb/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85/output.pdf">
    <edm:isShownBy rdf:resource="http://www.digitalna.nb.rs/attach/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85/output.pdf">
    <edm:Object rdf:resource="http://www.digitalna.nb.rs/wb/NBS/Tematske_kolekcije/Industrijsko_nasledje/borski_rudnici/Krvaso_plato/GM_85/pageIndex.html"/>
  </core:aggregation>
</core:aggregation>

```

Figure 1. An example of a record from Digitalna NBS after the conversion from COMARC/B into EDM

names of foreign authors are written etymologically). If available, the birth and death years are also included. One of those fields contains the link to the Wikidata¹⁵ database entry related to the author. Subsidiary authors (contributors) are placed within `<dc:contributor>`. The `<dc:format>` property is also repeatable and contains information about the physical copy of the material (dimensions, number of pages, etc.) and so is `<dc:description>`, in which the data on circulation and certain descriptive elements are entered, depending on availability. Subject headings are entered into `<dc:subject>` in Serbian and/or English for better data linking (language is marked within the `xml:lang` attribute). The `<dc:identifier>` property is a unique object identifier (the NBS uses the COBISS ID for this purpose). The metadata language is entered as `xml:lang` (a mandatory attribute for textual metadata), whereas `<dc:language>` is the language of the publication (for multi-language publications, this field is repeatable). Two-letter language codes are used, as per the ISO 639-1 standard.¹⁶ The publisher is placed within `<dc:publisher>` and `<dc:title>` contains the object title. The `<dc:terms:issued>` property is the year of publication, and `<edm:currentLocation>` is the place where the physical copy of the material is kept. This field contains a link to the

15. „Wikidata“

16. Wikipedia, „List of ISO 639-1 codes“

Geonames¹⁷ database. Defined values “TEXT” or “IMAGE” are entered into `<edm:type>`, depending on the type of material.

The `<ore:Aggregation>` class contains links to the webpage of the digitised object. The link toward the object is entered into `<ore:Aggregation>`, `<edm:aggregatedCHO>` and `<edm:isShownAt>`. The `<edm:isShownBy>` property contains the link to the PDF file (for textual material) or the full screen view of the image viewer. The `<edm:object>` property contains the link to the thumbnail. In addition to those links, the class also contains the `<edm:rights>` property, in which the assigned Creative Commons licence¹⁸ link is entered. The `<edm:provider>` property refers to the aggregator through which the data was submitted to Europeana, while `<edm:dataProvider>` is for the library that submitted the data to the aggregator.

Once ready, the EDM dataset is uploaded to the Aggregator for Europeana, which carries out an additional transformation after which the dataset is ready for publication on Europeana (Figure 2).

3 Europeana Publishing Framework

Europeana has established content and metadata description standards. The quality of content and metadata determines the way an object can be presented and promoted on the Europeana portal and defines if it can be downloaded. There are three levels of metadata¹⁹ quality: A, B and C.²⁰ The A level is the lowest, whereas the C level is the highest. Europeana’s principle is “The more you give, the more you get”,²¹ i.e. the richer the data, the better the search results. The A level means the content can be found on the pages of Europeana and the B level means it can also be used for different thematic collections and promotional activities (e.g. social media posts). The C level is the highest, meaning that it has the richest data. In addition to all that applies to the previous two levels, the C-level metadata can be used for various projects, applications and services. The records the NBS has so far delivered to Europeana predominately have the B-level metadata quality.

17. „GeoNames“

18. „Creative Commons“

19. Europeana, „Europeana Publishing Framework: Metadata“, accessed 15. 3. 2022

20. Tier A, Tier B, Tier C.

21. Europeana, „The more you give, the more you get“, accessed 18. 3. 2022

```

<?xml-namespace="http://www.openarchives.org/OAI/2.0/" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.openarchives.org/OAI/2.0/
http://www.openarchives.org/OAI/2.0/OAI-PMH.xsd"
<?responseDate="2022-10-18T10:58:16Z" <?responseDate>
<request metadataPrefix="edm" set="ECC_kun1_edkt_20_np" verb="ListRecords">http://aggregator.nb.rs/oai/OAIHandler/</request>
<?ListRecords>
<?records>
<?header>
<identifier>2354823</identifier>
<datestamp>2020-10-19T00:00:00Z</datestamp>
</header>
<?metadata>
<?rdf:RDF xmlns:core="http://www.openarchives.org/core/terms/" xmlns:owl="http://www.w3.org/2002/07/owl#" xmlns:skos="http://www.w3.org/2004/02/skos/core#"
xmlns:rdfs="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:edms="http://www.europeana.eu/schemas/edm/" xmlns:is13="http://www.w3.org/ns/odrl/2/"
xmlns:is14="http://www.w3.org/1999/02/22-rdf-syntax-ns#" xmlns:ns12="http://xmlns.com/foaf/0.1/" xmlns:is11="http://rdfs.org/sioc/services#"
xmlns:is15="http://www.dcu.ie/~lib/data/ontology/ebucore/ebucore#" xmlns:dcterms="http://purl.org/dc/terms/" xmlns:is16="http://www.europeana.eu/schemas/edm/enrichment#"
xmlns:is15="http://usefulinc.com/ns/doap#" xmlns:is14="http://creativecommons.org/ns#" xmlns:dc="http://purl.org/dc/elements/1.1/"
<?skos:Concept rdf:about="/direct/2354833">
<skos:prefLabel xml:lang="sr">Vojvođski košac hachef/</skos:prefLabel>
</skos:Concept>
<?edm:Agent rdf:about="/direct/2354828">
<skos:prefLabel xml:lang="en">Jovan Popović</skos:prefLabel>
<skos:note xml:lang="en">Latin script</skos:note>
<rdar2:dateTime1905</rdar2:dateTime>
<rdar2:dateTime1905</rdar2:dateTime>
</edm:Agent>
<?skos:Concept rdf:about="/direct/2354826">
<skos:prefLabel xml:lang="sr">Vojveđski košac hachef/</skos:prefLabel>
</skos:Concept>
<?edm:Agent rdf:about="/direct/2354829">
<skos:prefLabel xml:lang="en">Vojveđski košac hachef/</skos:prefLabel>
<skos:note xml:lang="en">Cyrillic script</skos:note>
<rdar2:dateTime1904</rdar2:dateTime>
<rdar2:dateTime1904</rdar2:dateTime>
</edm:Agent>
<?edm:Agent rdf:about="/direct/2354832">
<skos:prefLabel xml:lang="sr">Jovan Popović</skos:prefLabel>
<skos:note xml:lang="en">Cyrillic script</skos:note>
<rdar2:dateTime1905</rdar2:dateTime>
<rdar2:dateTime1905</rdar2:dateTime>
</edm:Agent>
<?edm:Agent rdf:about="/direct/2354827">
<skos:prefLabel xml:lang="sr">Abdulla Andrejević-Kun/</skos:prefLabel>
<skos:note xml:lang="en">Latin script</skos:note>
<rdar2:dateTime1904</rdar2:dateTime>
<rdar2:dateTime1904</rdar2:dateTime>
</edm:Agent>
<?edm:Agent rdf:about="/direct/2354830">
<skos:prefLabel xml:lang="sr">http://www.wikidata.org/wiki/Q1283347</skos:prefLabel>
</edm:Agent>
<?skos:Concept rdf:about="/direct/2354825">
<skos:prefLabel xml:lang="sr">Kosača</skos:prefLabel>
</skos:Concept>
<?edm:Agent rdf:about="/direct/2354824">
<skos:prefLabel xml:lang="sr">http://www.wikidata.org/wiki/Q6296683</skos:prefLabel>
</edm:Agent>
<?skos:Concept rdf:about="/direct/2354831">
<skos:prefLabel xml:lang="en">Industrial Heritage</skos:prefLabel>
</skos:Concept>
<?edm:ProvidedCHO rdf:about="URN:NBN:NLN:ed27476c7-f752-4a15-901b-e7e802b5f7eecho">
<dc:identifier>URN:NBN:NLN:ed27476c7-f752-4a15-901b-e7e802b5f7eecho</dc:identifier>
<dc:language>sr</dc:language>
<dc:terms:issued>1937</dc:terms:issued>
<edm:currentLocation rdf:resource="http://sus.geonames.org/792680/">
<dc:title xml:lang="sr">Krvavo zlato : 28 originalnih drvoreza Đ. Andrejevića-Kuna</dc:title>
<dc:description xml:lang="sr">Prvi žib, </dc:description>
<dc:description xml:lang="sr">Str. 1-11: Umjetnik i njegovo delo / J. Popović.</dc:description>
<dc:publisher xml:lang="sr">Đ. Andrejević-Kun</dc:publisher>
<dc:format xml:lang="sr">32 str., 28 listova s tablicama</dc:format>
<dc:format xml:lang="sr">drvorezi, crno-beloc</dc:format>
<dc:format xml:lang="sr">25 cm</dc:format>
<dc:subject rdf:resource="/direct/2354833/">
<dc:contributor rdf:resource="/direct/2354828/">
<dc:creator rdf:resource="/direct/2354829/">
<dc:contributor rdf:resource="/direct/2354832/">
<dc:creator rdf:resource="/direct/2354827/">
<dc:creator rdf:resource="/direct/2354830/">
<dc:type rdf:resource="/direct/2354825/">
<dc:contributor rdf:resource="/direct/2354824/">
<dc:subject rdf:resource="/direct/2354831/">
<edm:type>PAGE</edm:type>
</edm:ProvidedCHO>
<?core:Aggregation rdf:about="URN:NBN:NLN:ed27476c7-f752-4a15-901b-e7e802b5f7eecho">
<edm:aggregatedCHO rdf:resource="http://www.digitalna.nb.rs/ub/NBS/Tematske_kolekcije/Industrijsko_nasleđe/borski_rudnici/Krvavo_zlato/GH_85/">
<edm:dataProvider>National Library of Serbia</edm:dataProvider>
<edm:isShownAt rdf:resource="http://www.digitalna.nb.rs/ub/NBS/Tematske_kolekcije/Industrijsko_nasleđe/borski_rudnici/Krvavo_zlato/GH_85/">
<edm:isShownBy rdf:resource="http://www.digitalna.nb.rs/attach/NBS/Tematske_kolekcije/Industrijsko_nasleđe/borski_rudnici/Krvavo_zlato/GH_85/output.pdf/">
<edm:object rdf:resource="http://www.digitalna.nb.rs/ub/NBS/Tematske_kolekcije/Industrijsko_nasleđe/borski_rudnici/Krvavo_zlato/GH_85/pageIndex-thumb/">
<edm:provider>National Library of Serbia</edm:provider>
<edm:rights rdf:resource="http://creativecommons.org/licenses/by-nc-sa/4.0/">
</core:Aggregation>
</rdf:RDF>
</metadata>
</records>
</ListRecords>
</OAI-PMH>

```

Figure 2. The same record after the transformation carried out by the Aggregator for Europeana

When it comes to the content,²² the same principle applies. The better the quality, the better the reach of the content and the possibilities of its reuse. There are four levels of content quality: 1, 2, 3 and 4.²³ Just like with metadata, the lowest level only enables the objects to be found on Europeana, whereas the highest level enables reuse for commercial purposes, as well as the use on different platforms and applications. For some content to achieve level 4, it must have a licence enabling free use and reuse (PDM, CC-0, CC-BY, CC-BY-SA) (Kasadeval and Butigan Vučaj 2020). The content the NBS has delivered so far is mainly tier 3 or 4 (depending on the type of licence). Another factor influencing content quality is the presence of PDF files for textual materials (NBS implemented optical character recognition (OCR) as a mandatory step for textual materials in the PDF format). The library also adheres to the rule for the scanned material to be in the JPG format, resolution 0.95 MPIX, i.e. minimum size 1200x800 pixels²⁴ (which is a precondition for the tiers 3 and 4).

Since Europeana collects data from cultural heritage institutions across Europe and presents them within a single platform, it aims to minimise copyright limitations standing in the way of digitisation and free access. When it comes to copyright, the key document is Europeana Licensing Framework,²⁵ which serves to standardize and harmonize copyright-related information and practices so that the relationship between the end-users and data-submitting institutions is clear and transparent. Europeana uses the Creative Commons licences and the Rights Statements²⁶ licences, for which it is a co-founder.

4 Aggregation Infrastructure Improvement

The Europeana Common Culture project, which lasted from the beginning of 2019 until the end of 2020, was focused on the improvement of the aggregation infrastructure. As we have already mentioned, the project aimed at establishing common recommendations and standards, enriching metadata and enabling free access to the content, as much as possible. Europeana fully supports open access. Within the project, the NBS submitted 8 new collections and updated metadata for 15 collections, which had been incorporated into the Europeana platform through earlier projects. The aggregation

22. Europeana, „Europeana Publishing Framework: Content“, accessed 16. 3. 2022

23. Tier 1, Tier 2, Tier 3, Tier 4.

24. Europeana, „Europeana publishing guide“, accessed 16. 3. 2022

25. Europeana, „Europeana Licensing Framework“, accessed 16. 3. 2022

26. „Rights Statements“

infrastructure first had to be improved to enable updating the collections. Semantika, a Slovenian company, worked on the Aggregator for Europeana as a technical partner of the NBS. As part of the project, the Aggregator was updated in such a way as to be able to process geographic and temporal headings, metadata related to authors' and contributors' dates of birth and death, Wikidata links and scripts in which their names are written (this is important because the Serbian language has two scripts).

Figure 3 shows what the updated metadata on the author and contributor look like. The `<dc:creator>` and `<dc:contributor>` properties contain the years of birth and death, in addition to the names, and the `xml:lang` attribute contains the value `sr`, which stands for Serbian. The link toward the Wikidata database entry is entered as the value of the `rdf:resource` attribute.

```
<dc:contributor xml:lang="sr">Jovan Popović (1905-1952)</dc:contributor>
<dc:contributor xml:lang="sr">Јован Поповић (1905-1952)</dc:contributor>
<dc:contributor rdf:resource="http://www.wikidata.org/wiki/Q6296683" xml:lang="sr"/>
<dc:creator xml:lang="sr">Đorđe Andrejević-Kun (1904-1964)</dc:creator>
<dc:creator xml:lang="sr">Ђорђе Андрејевић-Кун (1904-1964)</dc:creator>
<dc:creator rdf:resource="http://www.wikidata.org/wiki/Q1283347" xml:lang="sr"/>
```

Figure 3. Metadata enrichment in a sample with a Serbian author and contributor

Figure 4 better illustrates the difference between the values of the `xml:lang` attribute. In this example, each author has three `<dc:creator>` properties in which their names are written in German (`xml:lang="de"`), Serbian Cyrillic and Serbian Latin. If there is no Wikidata entry for an author, that value is skipped (such is the case with Ludwig Erminy).

```
<dc:creator xml:lang="de">Ludwig Erminy</dc:creator>
<dc:creator xml:lang="sr">Ludvig Ermini</dc:creator>
<dc:creator xml:lang="sr">Лудвиг Ермини</dc:creator>
<dc:creator xml:lang="de">Franz Wolf (1795-1859)</dc:creator>
<dc:creator xml:lang="sr">Franc Wolf (1795-1859)</dc:creator>
<dc:creator xml:lang="sr">Франц Волф (1795-1859)</dc:creator>
<dc:creator rdf:resource="http://www.wikidata.org/wiki/Q2072339" xml:lang="sr"/>
```

Figure 4. Metadata enrichment in a sample with foreign authors

Those two examples are parts of two EDM.xml records. After an EDM record is generated, it is uploaded to the Aggregator for Europeana where it is further transformed. Each field is transferred into its equivalent field(s). The end result looks like this (Figure 5):

```
▼<edm:Agent rdf:about="/direct/2354828">
  <skos:prefLabel xml:lang="sr">Jovan Popović</skos:prefLabel>
  <skos:note xml:lang="en">Latin script</skos:note>
  <rdaGr2:dateOfBirth>1905</rdaGr2:dateOfBirth>
  <rdaGr2:dateOfDeath>1952</rdaGr2:dateOfDeath>
</edm:Agent>
▼<edm:Concept rdf:about="/direct/2354826">
  <skos:prefLabel xml:lang="sr">Ђорђе Андрејевић-Кун</skos:prefLabel>
</skos:Concept>
▼<edm:Agent rdf:about="/direct/2354829">
  <skos:prefLabel xml:lang="sr">Ђорђе Андрејевић-Кун</skos:prefLabel>
  <skos:note xml:lang="en">Cyrillic script</skos:note>
  <rdaGr2:dateOfBirth>1904</rdaGr2:dateOfBirth>
  <rdaGr2:dateOfDeath>1964</rdaGr2:dateOfDeath>
</edm:Agent>
▼<edm:Agent rdf:about="/direct/2354832">
  <skos:prefLabel xml:lang="sr">Јован Поповић</skos:prefLabel>
  <skos:note xml:lang="en">Cyrillic script</skos:note>
  <rdaGr2:dateOfBirth>1905</rdaGr2:dateOfBirth>
  <rdaGr2:dateOfDeath>1952</rdaGr2:dateOfDeath>
</edm:Agent>
▼<edm:Agent rdf:about="/direct/2354827">
  <skos:prefLabel xml:lang="sr">Ђорђе Андрејевић-Кун</skos:prefLabel>
  <skos:note xml:lang="en">Latin script</skos:note>
  <rdaGr2:dateOfBirth>1904</rdaGr2:dateOfBirth>
  <rdaGr2:dateOfDeath>1964</rdaGr2:dateOfDeath>
</edm:Agent>
▼<edm:Agent rdf:about="/direct/2354830">
  <skos:prefLabel xml:lang="sr">http://www.wikidata.org/wiki/Q1283347</skos:prefLabel>
</edm:Agent>
▼<skos:Concept rdf:about="/direct/2354825">
  <skos:prefLabel xml:lang="sr">књига</skos:prefLabel>
</skos:Concept>
▼<edm:Agent rdf:about="/direct/2354824">
  <skos:prefLabel xml:lang="sr">http://www.wikidata.org/wiki/Q6296683</skos:prefLabel>
</edm:Agent>
```

Figure 5. Part of an EDM record after the transformation carried out by the Aggregator (Serbian author and contributor)

The years of birth and death are placed in `<rdsGr2:dateOfBirth>` and `<rdsGr2:dateOfDeath>` in the `<edm:Agent>` class (representing the authors). If the years are not available, those properties are left out. The Wikidata link is placed within `<skos:prefLabel>`, while `<skos:note>` contains information on the script (Cyrillic or Latin). The programme is capable of detecting the script automatically.

The link to the record after being processed by the Aggregator is submitted to Europeana. The end result²⁷ is the following view of the metadata (Figure 6):

The screenshot shows the Europeana metadata page for the book "Krvavo zlato : 28 originalnih drvoreza Đ. Andrejevića-Kuna". The page includes the title, a "Read more" link, and a section for "COLLECTIONS YOU MIGHT LIKE" with buttons for "20th century" and "National Library of Serbia". Below this is a metadata table with two tabs: "Good to know" (selected) and "All metadata".

Good to know		All metadata
Providing institution	National Library of Serbia	
Contributors	Јован Поповић ; http://www.wikidata.org/wiki/Q6296683 ; Jovan Popović	
Creator	http://www.wikidata.org/wiki/Q1283347 ; Ђорђе Андрејевић-Кун ; Đorđe Andrejević-Kun	
Publisher	Đ. Andrejević-Kun	
Subject	Ђорђе Андрејевић-Кун ; Индустрijско наслеђе ; Industrial Heritage	
Type of object	књига	

Figure 6. Metadata for a single object on Europeana

27. „Krvavo zlato: 28 originalnih drvoreza Đ. Andrejevića-Kuna“

Geographic and temporal headings are also new. EDM records now contain `<dcterms:spatial>` and `<dcterms:temporal>`, which are transformed by the Aggregator into `<edm:Place>` and `<edm:TimeSpan>`.

A sample of a geographic and a temporal heading in an EDM record is given in Figure 7.

```
<dcterms:issued>1921</dcterms:issued>
<dcterms:spatial xml:lang="sr">Југославија</dcterms:spatial>
<dcterms:temporal xml:lang="sr">1921</dcterms:temporal>
<edm:currentLocation rdf:resource="http://sws.geonames.org/792680/" />
```

Figure 7. A geographic and a temporal heading in an EDM record

After being processed by the Aggregator, the record looks as shown in Figure 8.

```
▼<edm:Place rdf:about="/direct/2352735">
  <skos:prefLabel xml:lang="sr">Југославија</skos:prefLabel>
</edm:Place>
▼<edm:TimeSpan rdf:about="/direct/2352732">
  <skos:prefLabel xml:lang="sr">1921</skos:prefLabel>
</edm:TimeSpan>
```

Figure 8. Record shown in Figure 7 after being processed by the Aggregator

The most recent aggregation infrastructure update at the NBS consists in enabling the processing of IIIF²⁸ records. This is an open standard for the online delivery of high-quality digital objects. The abbreviation also refers to the international open community for the development and implementation of this technology with the support of consortia made up of the leading cultural heritage and academic institutions. The initiative to perform this update originated from the Milutin Bojić Library in Belgrade. After the update, the Aggregator will be able to process the datasets coming from the libraries that have implemented the IIIF standard. The EDM specification for IIIF entails 4 steps:

28. “IIIF”

1. Submitting a IIIF Resource as `<edm:WebResource>`, which practically means listing a `WebResource` identifier, the purpose of which is to “review” the object and identify the connection type between a IIIF Resource and the object itself;
2. Indicating that the `<edm:WebResource>` is IIIF compliant, which means to link the `WebResource` to a source of the `<svcs:Service>` type, as well as to state that the `WebService` corresponds to the IIIF profile;
3. Indicating the level of IIIF implementation via `<doap:implements>`;
4. Enabling access to the IIIF manifesto directly or indirectly via `<dc-terms:isReferencedBy>`.

A segment of a sample EDM record pertaining to a digital object from the Milutin Bojić Library (*Beleznica Milutina Bojića*,²⁹ a manuscript) illustrating what the Aggregator is required to submit for publication on Europeana is presented in Figure 9.

```

<!--
  edm:WebResource class - contains all information about the
  digital version of the CHO only-->
  <edm:WebResource
rdf:about="https://milutinbojic.digitalna.rs/servlet/ImageTileRenderer?doc_id=0fbe53e1-56af-416f-9d98-79f165e07d4c/00000001/ruko
pis1/00000021&amp;pg_seq=1&amp;search_doc=&amp;scale=0.2&amp;rotation=0"
  <dc:format>jpg</dc:format>
  <dc:terms:isReferencedBy
rdf:resource="https://milutinbojic.digitalna.rs/iiif/api/presentation/2/0fbe53e1-56af-416f-9d98-79f165e07d4c&252F00000001&252Fru
kopis1&252F00000021/manifest"/>
  <svcs:has_service
rdf:resource="https://milutinbojic.digitalna.rs/iiif/api/image/2/0fbe53e1-56af-416f-9d98-79f165e07d4c&252F00000001&252Frukopis1&252
252F00000021&252F0"/>
  </edm:WebResource>
<!--
  svcs:Service class - contains all information about the
  IIIF resource-->
  <svcs:Service
rdf:about="https://milutinbojic.digitalna.rs/iiif/api/image/2/0fbe53e1-56af-416f-9d98-79f165e07d4c&252F00000001&252Frukopis1&252
F00000021&252F0">
  <dc:terms:conformsTo rdf:resource="http://iiif.io/api/image"/>
  <doap:implements rdf:resource="http://iiif.io/api/image/2/level2.json"/>
  </svcs:Service>

```

Figure 9. EDM segment for IIIF

5 Conclusion

Thanks to the cooperation with Europeana and the work on developing the Aggregator, the National Library of Serbia has adopted certain rules

29. Milutin Bojic Library – Digital Repository, “Beleznica Milutina Bojića”

and recommendations set forth by Europeana (EDM, minimum dimensions of scanned objects, OCR for PDF documents, copyright licences). This way, the library has implemented European standards in the area of cultural heritage. More importantly, it has proven that this can be done even with a small expert team. The following steps include the publication of new content on Europeana and continuous work on further improvement of content and metadata quality and the Aggregator. Further plans will evolve in two directions: including new data-submission partners to present Serbian culture within the European framework and implementing the rules and standards that Europeana adopts in the future.

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