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CLARIN CASE STUDY

Making Europeana's resources available for research purposes through the CLARIN infrastructure

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Outline

Introduction	2
The Challenge	3
Implementation	4
Selection of content	4
Retrieval of metadata	8
Integration of resources into the infrastructure	9
Promotion and usage	12
Usage statistics for the imported records	13
Outcomes and lessons learned	14
Focus on quality and usable outcomes for the researcher	14
Need for targeted promotion of the integrated datasets	14
Evidence-based recommendations for future implementations	15

Introduction

As a networked federation of language data repositories, service centres and centres of expertise, CLARIN makes digital language resources available to scholars, researchers, students and citizen-scientists from all disciplines, especially in the humanities and social sciences, through single sign-on access. By offering long-term solutions and technology services for deploying, connecting, analysing and sustaining digital language data and tools, CLARIN supports scholars who want to engage in cutting edge data-driven research, contributing to a truly multilingual European Research Area.

The CLARIN infrastructure is envisaged to support the researchers who focus on diverse languages, and on diverse types of language modalities (such as hand-written or machine-readable digitised text, speech, sign language content). Cultural heritage (CH) provides a rich source of diverse and relevant content. CLARIN has been involved as a partner in Europeana's Digital Service Infrastructure (DSI) from the start of this project in April 2015 with the aim of making content accessible and discoverable to its community. By working towards this goal, and in the process increasing exposure and awareness of the availability of such content, this collaboration opens up new opportunities for the broader research community to conduct multilingual and multimodal research in humanities and social sciences, and, for example, to integrate diverse data relevant to the same topic.

With this case study, we present an example of a successful integration of cultural heritage material from Europeana into a digital research infrastructure by means of an effective exploitation of Europeana services to support researchers. Although the work and its outcomes are rooted into efforts carried out during earlier stages of the Europeana DSI, we primarily describe the work that took place during the first half of the DSI-4 project period (September 2018 to August 2019), specifically the various aspects of content integration and related outreach activities.

The Challenge

The essential challenge for CLARIN with respect to cultural heritage resources is to establish a trajectory for conversion from language representations of all kinds and from many sources, to usable research data. By this we mean readily usable resources with good quality data and metadata of diverse nature, ranging from data provision information to additional information layers such as transcriptions or annotations, that allow scholars to carry out analysis and processing with the tools available within the research domain.

The challenges stemming from the wide range of locations offering (access to) cultural heritage resources is largely mitigated by Europeana's aggregation of resource metadata. Combined with the established metadata standardisation, curation and distribution, Europeana provides a solution that delivers high 'recall'. The total number of cultural heritage objects that can be accessed this way is growing and currently approaching 60 million, making up many thousands of separate (semi-)structured datasets. Therefore, to increase the value of this content for CLARIN core/target research community we aim to only aggregate and disseminate resources that:

- Are relevant to the area of interest of the Social Sciences and Humanities community in general, and to the CLARIN core research groups focusing on the language processing in particular, in terms of content.
- Are of sufficient quality. There are many aspects to the quality of a resource, such as correctness (for example in the case of OCR'd text), resolution (of images, audio and video), recording quality, and completeness and correctness of the description (metadata quality).
- Meet the technical requirements for typical analysis and processing tasks. Resources need not only to be identified and described, but also directly accessible via the provided URL in the expected format. Furthermore, the media types of the content files (e.g. plain text, JPEG, MP3) need to be accurately represented in the metadata.

Resources fulfilling these criteria are to be integrated into the 'native' ecosystem of CLARIN, thus allowing scholars within the broader social sciences and humanities (SSH) community to easily discover resources and to use them as input for further research using tools and services available within this infrastructure.

In trying to achieve this objective, we identified a number of **concrete questions**:

- How can we make a selection of records matching the criteria listed above? One cannot manually assess and curate the content of all available datasets. Instead, a set of criteria must be defined, preferably of a nature that at least partially supports automatic (pre)filtering.
- How can we retrieve ('harvest') the metadata in a reliable, performant way - ideally without having to implement a custom solution in the form of an API client?
- How should we process the retrieved metadata such that both the metadata itself and the corresponding resources can be integrated into our existing research infrastructure in a way that fits all relevant technical constraints and delivers the highest quality experience to the user?
- How can we set up a reliable workflow for regularly, and if possible automatically, carrying out these steps of selection, retrieval and integration?

In the remainder of this case study we will describe our approach towards answering these questions and tackling the underlying challenges along with some concrete outcomes, and conclude with an analysis of the impact of our work. We will also describe outreach activities we carried out with the aim of increasing awareness of Europeana, its resources and the integration with the research infrastructure among CLARIN's target audiences.

Implementation

Selection of content

As stated above, we aimed to select content for reuse in research that is relevant to the broader SSH community, being of sufficient quality and technically suitable for analysis and processing. Europeana's Search API [1] provides facilities for retrieving datasets on the basis of several properties from the metadata in the records. This allowed us to narrow down, for our initial evaluation, a relatively small subset of potentially highly relevant datasets without having to spend a lot of time going through all sets manually. By only accepting datasets that, based on information available from the API, contain at least some records with full-text content [2] we reduced the number of candidate sets from the total of (at time of evaluation) 2,183 to only 145.

Using the same Search API, we collected some basic properties for each set, such as the number of records, object types (text, image, audio, video) included, languages and media types in tabular form. Making use of the dataset identifiers we could also automatically generate and include links to the online collection viewer at Europeana Collections [3].

Using the table of candidate datasets, it was straightforward to go through the remaining collections, sampling and manually inspecting their contents to evaluate each of them on the basis of a set of concrete criteria:

1. Presence of actual 'language content'.
2. Quality of full-text content and/or image quality.
3. Quantity and completeness of (English) metadata.
4. Correctness and consistency of the available metadata.
5. Technical accessibility of resource downloadable and processable content (files) through the metadata.
6. Reusability within a research context from a legal point of view (non-commercial use attribution are acceptable conditions).
7. Processability within the CLARIN infrastructure.

Note that the final criterion in this list depends on tools availability through the CLARIN infrastructure at least as much as on the format in which the CH content is provided. Nevertheless, this is an important criterion for inclusion in the light of the objective to provide a complete, unified workflow from discovery to processing.

[1] <https://pro.europeana.eu/resources/apis/search>

[2] This involves two attributes: type (= text) and fulltext (= true)

[3] www.europeana.eu

The process of manual inspection led to rejection of about two-thirds of the remaining datasets. There were various reasons for rejecting a specific dataset upon closer inspection. Some common reasons were:

- No or very little actual full-text or otherwise machine-usable content (such as high resolution digitised manuscripts) in the dataset despite such indication in metadata.
- Poor quality of the full-text content to a degree that renders it unsuitable for linguistic processing.
- Resource files could not be accessed via the metadata due to broken links.
- Resource content is accessible via an in-browser viewer, but not downloadable or directly accessible in a way that allows for external processing.
- Unclear licensing condition or too restrictive licence, inconsistent licensing information, e.g. different licences stated in metadata and on the resource page.
- Metadata largely only available in language(s) other than English.
- Content is of limited interest in unprocessed form, for example datasets consisting mainly of 'secondary' (academic) resources such as research papers or reports on cultural heritage objects.

After this stage of evaluation, a 'short list' of 43 highly promising candidates remained. Some of these sets were considered to be only interesting in part, for example cases of highly diverse collections bundling together various types of visual content such as sheet music as well as text, or having varying reuse conditions within a single dataset.

Nevertheless, the quality and relevance of the targeted resources within these sets was generally considered to be high enough to warrant partial retrieval of the sets although this required implementing filtered retrieval on basis of cultural heritage object properties.

The final selection was made by carrying out an actual retrieval of all preselected sets and filtering by means of the faceting options provided by Europeana's API. Filtering criteria were selected in line with the nature of each of the sets. In most cases, full text and freely available resources were set as filtering conditions. In a few cases, full text did not apply (audio and manuscripts), and therefore full text was not set as a filtering condition. In a number of cases, the 'open' filter, which restricts the returned results to resources that are marked as being freely available without conditions, had to be omitted so as not to exclude collections with a 'non-commercial use' condition.

A selection of 18 sets (see Table 1) remained after this final evaluation step. These collections were staged for ingestion into the Virtual Language Observatory (VLO), CLARIN's solution for resource exploration and discovery for scholars and others interested in language resources. In August 2019, the total number of records retrieved from these collections and ingested in the VLO is 135,234 after filtering (see next section).

Set identifier	Data provider	CH object count
9200114_Ag_EU_TEL_a0516_Bulgaria_Manuscript	National Library of Bulgaria	78
92068_Ag_Slovenia_ETravel	National and University Library of Slovenia	621
2022411_Ag_RO_Elocal_audioinb	Aman Library	30
2022402_Ag_RO_Elocal_arhivele	Arhivele Naționale, Serviciul Județean Cluj	194
0940429_Ag_PL_www.bibliotekacyfrowa.pl	Biblioteka Cyfrowa Uniwersytetu Wrocławskiego	31,053
0940442_Ag_PL_bibliotekacyfrowa.eu	Bałtycka Biblioteka Cyfrowa	7,111
0940431_Ag_PL_rcin.org.pl	Repozytorium Cyfrowe Instytutów Naukowych	78
0940433_Ag_PL_mbc.malopolska.pl	Małopolska Biblioteka Cyfrowa	333
15416_L_IE_IMC_oireachtas	The Oireachtas Library & Research Service	1,407
2022410_Ag_RO_Elocal_documen1	Dolj County Library	11
9200394_Ag_Slovenia_Laibacher_Zeitung	National and University Library of Slovenia	59,379
9200452_UL_Old_Rare_Books_Lucian_Blaga	National Library of Bulgaria	78
9200452_UL_Old_Rare_Books_Lucian_Blaga	Lucian Blaga Central University Library, Cluj-Napoca, Romania	174
9200453_UL_Manuscripts_Lucian_Blaga	Lucian Blaga Central University Library, Cluj-Napoca, Romania	48
0940431_Ag_PL_rcin.org.pl	Repozytorium Cyfrowe Instytutów Naukowych	78
9200467_Ag_TEL_a1188_eCloud_Debrecen	The University and National Library of Debrecen	10,689
9200470_UL_Periodicals_Lucian_Blaga	Lucian Blaga Central University Library, Cluj-Napoca, Romania	7,178
9200498_Ag_BnF_occitanica	CIRDÒC-Mediatèca occitana	696
92054_Ag_Slovenia_Dom_in_sve	National and University Library of Slovenia	11,738
92055_Ag_Slovenia_Ljubljanski_zvon	National and University Library of Slovenia	4,152

Retrieval of metadata

Retrieval of metadata is a crucial first step towards integrating the selected datasets into the CLARIN research infrastructure. Retrieval implies consuming content from a distribution mechanism; Europeana already distributes metadata for their cultural heritage objects in several ways. Using the Search and Record APIs [4], one can discover datasets and records within these datasets, and retrieve metadata for records, structured according to the Europeana endpoint implementing the Open Archives Initiative Protocol for Metadata Harvesting [5] (OAI-PMH). OAI-PMH is a broadly adopted standard for metadata distribution, and has been used by CLARIN to ‘harvest’ metadata from its centres and other parties for many years. Therefore we strongly prefer using this mechanism for retrieval of metadata records from Europeana rather than implementing a solution on top of the dedicated APIs, notwithstanding their powerful features.

CLARIN is using a custom (but generally applicable) OAI-PMH harvesting client called the OAI Harvest Manager [6] that allows for the configuration of a metadata extraction and conversion pipeline. This is useful as it enables ‘plugging in’ the processing required to convert EDM metadata to a format supported by the CLARIN infrastructure, and to filter out irrelevant records on basis of metadata properties on the fly.

The OAI Harvest Manager also supports ‘incremental harvesting’, which, if supported by the metadata providing endpoint, introduces the possibility of updating a local copy or representation of one or more datasets on the basis of a changeset, rather than having to carry out a full harvest on a regular basis. Especially for harvesting larger (super)sets, this facility makes frequent metadata retrieval more feasible. However, incremental harvesting is currently not supported by Europeana’s OAI-PMH endpoint.

CLARIN’s harvest manager also supports filtering records on basis of metadata content. This could in principle be applied to retrieve subsets of collections, limiting retrieval to, for example, records describing full-text resources only or resources supporting certain usage scenarios. However, in the process we found some relevant properties lacking in the provided metadata, in particular the property to indicate whether full-text content is available. As this is an important property for CLARIN’s use case, we set up a pre-filtering mechanism where identifiers of records meeting the predefined conditions are determined through Europeana’s Search API after which the records themselves are retrieved, using their identifier as a filtering property, via OAI-PMH. Further streamlining could be achieved if the metadata as distributed by Europeana were to be enriched with the filtering properties that are available via the Search API.

[4] <https://pro.europeana.eu/resources/apis>

[5] <https://www.openarchives.org/pmh/>

[6] <https://github.com/clarin-eric/oai-harvest-manager>

Integration of resources into the infrastructure

Now that we have established a method of retrieving metadata, per dataset, from Europeana, several further actions were required to make this metadata actually available and usable for the users of the CLARIN infrastructure. To reiterate, the objective was to make relevant cultural heritage objects discoverable and available for analysis to these users in a familiar and easy way.

The first necessary post-processing step on top of the harvested (and filtered) EDM metadata is a conversion to a metadata format supported by the infrastructure [7]. The CLARIN metadata infrastructure is based on the Component Metadata (CMD) standard - generally referred to as the CMD Infrastructure or CMDI. The CMD model does not define one fixed structure or schema for all compliant metadata; rather, it allows for the definition of 'blueprints' and provides means for semantic 'grounding' of the constituents of these blueprints through references to a so-called 'concept registry' [8]. CMD is fully based on XML technology; in contrast to EDM, it is not based on W3C's Resource Description Framework (RDF). Conversion from EDM to CMD was implemented by means of Extensible Stylesheet Language Transformations (XSLT, or 'stylesheet') taking the RDF/XML representation of an EDM record as input and producing CMDI-compliant metadata based on a dedicated EDM-CMDI profile [9]. The stylesheet can be plugged into the configuration of the OAI Harvest Manager so that all retrieved EDM metadata gets converted to CMDI on the fly.

Once converted to CMDI, the records can be imported into the Virtual Language Observatory (VLO), CLARIN's metadata driven resource discovery platform. The import process fulfills two main tasks for each record:

1. Mapping of values from the record to the set of fields defined in the backend of the VLO.
2. Indexing of these values to support good performance querying and faceted browsing.

The first task, mapping, consists of various stages. Initially, the record is scanned for values that can be associated with VLO fields on the basis of the semantic links provided by the profile on which the record is based. Then, depending on the field, one or more post-processing and value normalisation actions are carried out in order to derive the value which is to be indexed and displayed.

[7] Note that an alternative approach would be to adapt the infrastructure to support EDM more centrally but this would require substantially more effort and does not scale well.

[8] CMD, CMDI and related concepts are explained in detail at <https://www.clarin.eu/cmd>

[9] More details and the conversion implementation can be found at <https://github.com/clarin-eric/metadata-conversion>



Virtual Language Observatory Search Contributors Help


VLO / Faceted search / Search results / Record: Poknežena grofija Goriška in Gradiščanska

Record 13 of 613

Poknežena grofija Goriška in Gradiščanska


Record details Links (8) Availability All metadata Technical details

Name	Poknežena grofija Goriška in Gradiščanska
Description	Prírodovnanski, statistični in kulturni opis : (22 podob). - 1802 (Ljubljana: R. Miličeva tiskarna). - 116 str.
Collection	EuropeanaTravel: The Digital Library of Slovenia <input type="text"/>
Language	Slovenian <input type="text"/>
Multilingual	No <input type="text"/>
Country	Slovenia <input type="text"/>
Organisation	National and University Library of Slovenia <input type="text"/> Slovenian National E-content Aggregator <input type="text"/>
Resource type	text <input type="text"/>
Data provider	Europeana <input type="text"/>



Landing page
https://www.europeana.eu/porta/record/92058/JURN_NBN_SI_DOC_WSRPXE3M_html

Linked resources



7 resources

A resource harvested via Europeana in CLARIN's Virtual Language Observatory. Screenshot by the authors.



A resource and two examples of processing initiated via CLARIN's Language Resource Switchboard. Left: First page of the pamphlet 'To all the good people of Ireland, friendly and seasonable advice' [10]. The Oireachtas Library & Research Service., Ireland, Public Domain; Top-right: partial view of WebLicht [11] Easy Chain for Dependency Parsing output; Bottom-right: Relative frequency of the terms 'evil', 'friend', and 'good' as plotted by the Voyant tool for distant reading [12]. Screenshots by the authors.

[10] https://www.europeana.eu/portal/en/record/15416/Data_Library3_Library3_DCT098003_pdf.html

[11] https://weblight.sfs.uni-tuebingen.de/weblightwiki/index.php/Main_Page

[12] <https://voyant-tools.org/>

Promotion and usage

After the integration completion, the different aspects of the work have already been presented in blogs on both Europeana and CLARIN channels and at relevant events.

Activity	Description	Location	Date	Outrech
EOSC-hub Week 2019 [13]	Demo [14] 'CLARIN-ERIC tools - Enabling discovery, processing and collection creation with integrated services for (language) resources' by André Moreira, Twan Goosen, Dieter Van Uytvanck, Willem Elbers The EOSC-hub Week 2019 brings together both present and future service providers and users of the European Open Science Cloud (EOSC) [15], and thus attracts participants from a broad range of research domains.	Prague, Czech Republic	10 April 2019	Twitter feed excerpt [16]
Blogs	CLARIN blog post 'CLARIN and Europeana make discovery and processing quick and easy for 135,000 cultural heritage objects'	Europeana Pro CLARIN website	8 April 2019	239 views in total
Publications	Virtual Language Observatory feature	EOSC Magazine [17]	10 Sept 2018	EOSC community

The integration, outcomes and the lessons learned will be further promoted at forthcoming events, such as CLARIN Annual Conference 2019 [18] in Leipzig in October and Europeana 2019 conference [19] in Lisbon in November.

[13] <https://www.eosc-hub.eu/events/eosc-hub-week-2019>

[14] <https://www.eosc-hub.eu/events/eosc-hub-week-2019/demos>

[15] <https://www.eosc-portal.eu/>

[16] <https://twitter.com/EurResearch/status/1115198627671101440?s=20>

[17] <https://www.eosc-hub.eu/clarin-vlo>

[18] <https://www.clarin.eu/event/2019/clarin-annual-conference-2019-leipzig-germany>

[19] <https://pro.europeana.eu/page/europeana-2019>



Usage statistics for the imported records

The following table shows access statistics gathered by CLARIN and Europeana for the subset of visits to the VLO that include a pageview of one or more records retrieved from Europeana within the VLO.

Month 2019	Europeana Records in VLO (% of total)	Visits with Europeana record view (% of total visits)	Pageviews for Europeana records (% of total pvs)	Europeana.eu referral traffic: users	Europeana.eu referral traffic: visits
February	747,769 (45.2%)	13 (1.4%)	36 (1.5%)	No data	No data
March	135,234 (12.9%)	11 (1.0%)	24 (0.9%)	No data	No data
April	135,234 (11.9%)	16 (1.3%)	46 (1.5%)	6	13
May	135,234 (13.3%)	17 (1.78%)	45 (2.2%)	6	7
June	135,234 (13.3%)	34 (3.1%)	69 (2.3%)	6	7
July	135,234 (13.2%)	26 (2.6%)	33 (1.5%)	4	5
August	135,234 (13.2%)	34 (3.2%)	52 (2.3%)	2	4

Notes:

- In March 2019, the new selection of records was incorporated into the VLO. In April, the new selection was highlighted through a blog post. Therefore, in terms of impact analysis the usage stats period starts with April 2019.
- Due to technical restrictions, the referral data to europeana.eu could not be measured before April 2019.

Outcomes and lessons learned

Focus on quality and usable outcomes for the researcher

At the start of 2019, CLARIN had been structurally harvesting and offering Europeana resources for reuse for over a year. While a fairly large selection of metadata was included (776,000 cultural heritage objects), quality was relatively low on average, especially in terms of metadata which reduced discoverability as well as potential for processing and integration. We expected the recent iteration of selection and integration to yield a substantially more usable outcome. As a result of metadata improvements on the side of Europeana and its aggregators and content providers, and a more extensive selection process, a smaller number of very high-quality cultural heritage objects, many of which have direct processing potential, have now replaced the earlier selection in the VLO.

Need for targeted promotion of the integrated datasets

The newly integrated Europeana datasets represent around 13% of all records available on VLO, a rather small selection among the rich and abundant language resources available on CLARIN's virtual catalogue. So far, they have registered limited access and usage rates, partly due to the summer holiday period. It is also worth noting that the reporting period is too short for completing research projects with Europeana records which would lead to more referral traffic to Europeana. That said, the stats clearly indicate the need for more targeted promotion of the Europeana records on VLO to channel the attention of researchers to the Europeana selection and encourage its reuse. In the near future, CLARIN and Europeana will look at how best to reach relevant research communities, including but not limited to news items on CLARIN and Europeana websites, joint publications and presentations at scientific conferences, and specially organised events, e.g. workshops and hackathons. These outreach are activities also seen as an opportunity to collect feedback from users and get a deeper understanding of their needs, thus contributing to improved technological solutions.

Evidence-based recommendations for future implementations

The work carried out jointly by Europeana and CLARIN within DSI-4 thus far has led to a better understanding, on both sides, of the technical and practical issues in the process of evaluating, selecting and integrating Europeana cultural heritage resources into a research infrastructure. We have developed better evaluation criteria and formulated clear steps towards an effective process, by always making quality a priority. This improved workflow can easily be repeated periodically or when new, potentially interesting data is known to have been introduced. Our experience can also benefit other researchers looking for any degree of integration of cultural heritage data into their tools for resource discovery and processing, or other similar applications. Below are the most important standing recommendations for Europeana and its data providing partners interested in making their data available for reuse in research.

Recommendations for Europeana Foundation and CHIs

- Implement and operate broadly supported mechanisms for metadata distribution in a stable and reliable way as part of Europeana's core service platform. Specifically, the OAI-PMH endpoint should be capable of delivering large volumes of metadata at a high rate without disruptions.
- Europeana data providers and aggregators should ensure the delivery of rich, linked metadata that can serve as a starting point for the discovery of content, and, in particular, full-text content.
- Europeana data providers and aggregators should be encouraged to offer relevant CH datasets as bundles that are homogenous in terms of origin and content type, possibly even curated for general or specific research use.

The impact of CLARIN-Europeana collaboration within DSI-4 can be seen in how it is addressing two priorities of the Europeana Innovation Agenda [20]:

- **Institutional strategy and impact/Maximising audience engagement:** The import of filtered Europeana content into VLO enables the researchers to find, to work with, and to reuse this cultural heritage data. The availability of various language processing tools and pipelines allows and encourages scientific experiments amongst both technologically advanced researchers as well as less experienced target audiences. Moreover, the access to a database of heterogeneous sources encourages the end-users to combine those in their research.
- **Technological Innovation:** As CLARIN follows the FAIR principles in its work, the CH resources that are integrated using the above-described selection procedure are immediately actionable for research purposes. In addition, this integration enhances the retrieval and usability of cultural heritage content in research by ensuring simultaneous access to multilingual content (Europeana records available on VLO) and CLARIN's language tools and services for its processing, once the data is converted into a suitable machine-processable format.

That said, a proper impact assessment of this integration would require a longer monitoring period and a focus on qualitative parameters, taking into consideration the timescales and nature of the research work. The Key Impact Pathways Indicators identified in the 9th EU Framework Programme for Research and Innovation suggest to consider our work as an outcome that can be perceived only as 'shared knowledge' in the short term, that will lead to knowledge diffusion in the mid term, and to new trans-sectoral and trans-disciplinary collaborations in the long run [21].

[20] https://pro.europeana.eu/files/Europeana_Professional/Innovation_Agenda/Europeana%20Innovation%20Agenda.pdf

[21] European Commission - Directorate-General for Research and Innovation, A New Horizon for Europe. Impact Assessment of the 9th EU Framework Programme for Research and Innovation, Luxembourg 2018, p. 146:

https://ec.europa.eu/info/sites/info/files/research_and_innovation/contact/documents/horizon_europe_impact_assessment_book_web_version.pdf

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