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D5.5 Final report on aggregation toolset

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Authors: Natasa Sofou, NTUA
Vassilis Tzouvaras Name, NTUA

Abstract: This document reports on the deployment of the fully functional updated aggregation system, contributing to task T5.3 *Aggregator deployment and maintenance*, and uses the outcome of task T5.1 *Aggregation infrastructure design*, as well as reporting experience obtained in task T5.2 *Aggregation infrastructure evaluation* and task T2.5 *Crowdsourcing infrastructure*. The aggregation, as described throughout the document, is a two-phase process. The first phase is handled by the MINT ingestion platform, the stage where data providers get involved in the aggregation process. In the second phase, transformed metadata are delivered to Europeana in EDM via an OAI repository and are then handled and published on Europeana website. All details about each phase of the aggregation, along with the aggregation functionalities involved, are presented in the document.

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Statement of originality

This document contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

Project summary

Europeana Sounds is Europeana's 'missing' fifth domain aggregator, joining APEX (Archives), EUscreen (television), the Europeana film Gateway (film) and TEL (libraries). It will increase the opportunities for access to and creative re-use of Europeana's audio and audio-related content and will build a sustainable best practice network of stakeholders in the content value chain to aggregate, enrich and share a critical mass of audio that meets the needs of public audiences, the creative industries (notably publishers) and researchers. The consortium of 24 partners will:

- Double the number of audio items accessible through Europeana to over 1 million and improve geographical and thematic coverage by aggregating items with widespread popular appeal such as contemporary and classical music, traditional and folk music, the natural world, oral memory and languages and dialects.

- Add meaningful contextual knowledge and medium-specific metadata to 2 million items in Europeana's audio and audio-related collections, developing techniques for cross-media and cross-collection linking.

- Develop and validate audience specific sound channels and a distributed crowd-sourcing infrastructure for end-users that will improve Europeana's search facility, navigation and user experience. These can then be used for other communities and other media.

- Engage music publishers and rights holders in efforts to make more material accessible online through Europeana by resolving domain constraints and lack of access to commercially unviable (i.e. out-of-commerce) content.

These outcomes will be achieved through a network of leading sound archives working with specialists in audiovisual technology, rights issues, and software development. The network will expand to include other data providers and mainstream distribution platforms (Historypin, Spotify, SoundCloud) to ensure the widest possible availability of their data.

For more information, visit http://pro.europeana.eu/web/europeana-sounds and http://www.europeanasounds.eu

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Contents

Executive summary

The aim of WP5 is to enable metadata aggregation by extending and enhancing the existing Europeana aggregation infrastructure and deliver high quality metadata to Europeana. In order to maximize the quality of delivered metadata, it was envisaged that a number of services for metadata enrichment such as cleaning and normalization would be designed, deployed and become available to data providers.

Based on the experience gained so far as well as on a set of simple use cases created especially based on the needs of Europeana Sounds users, the needs for enrichment were exploited and the new services to meet these needs were identified. The enrichment of aggregated metadata records is approached through three main processes. The first one is that of data cleaning. In this case the data provider is able to cleanse the data. Typographical errors are corrected and it is possible to conform to specific conventions easily, among others. The second methodology is data reconciliation, whereby users can align their metadata to vocabularies provided by WP1. The last methodology, which is complementary to data reconciliation, is that of linking the metadata records to external resources. This method is automatic and is available after the metadata are ingested to Europeana servers.

This document reports on newly delivered services as well as combination of already existing ones that enable data providers to:

- Clean their metadata and normalize them using selected SKOS thesauri

- Browse their contributed items in the EDM profile and filter them based on specific elements, values and search criteria

- Manipulate a dataset on a record level: i) create a new record or dataset from scratch ii) edit values of a record iii) entirely delete a record

- Group edit the resulted item set in order to perform a set of predefined actions such as: i) data cleaning- correct typographic errors ii) data reconciliation: align metadata elements with the sounds thesaurus.

1 Introduction

1.1 Background

Europeana Sounds focuses specifically on audio and audio-related content, primarily music and speech audio, including out-of-commerce recordings and a large number of unpublished works from Europe's major sound archives that are not widely available. Efficient ingestion of this audio and audio-related metadata is one of the main objectives of the project and requires an aggregation platform as well as a content selection policy. Within the Europeana Sounds project the aim of WP5 was primarily to enable metadata aggregation. Metadata aggregation services are handled by the MINT[1] platform.

1.2 Scope

Europeana Sounds' aggregation workflow is implemented using the MINT platform, the Europeana Data Model - Sounds Profile specification (see D1.4 *EDM profile for sound*), and the Europeana Sounds Ontologies as introduced in D1.3 *Ontologies for sound*. The operation of the aggregation is planned and monitored by WP1 in order to coordinate data provision (workflow guide, publication cycles, contingency planning etc.). The technical infrastructure is implemented, monitored and maintained by WP5 in order to support the activities of WP1, to implement the project specifications, and enable emerging ingestion and publication requirements.

1.3 Related documents

D1.3 *Ontologies for sound*: the recommendations from work on ontologies and language.

D1.4 *EDM profile for sound*: the result from the working group defining audio extensions to EDM.

MS23 *Revised aggregation design available* – outlines the basic components of aggregation infrastructure.

MS24 *Aggregation infrastructure prototype available* – reports on the delivered prototype that offers aggregation services such as registration and metadata import, mapping and transformation, and publication

MS25 *Sounds SKOS ontology normalization and cleaning module beta* – outlines advance functionalities of aggregation mechanism.

MS26 *Aggregation mechanism ready* – reports on the delivery of the aggregation mechanism.

D5.1 *Report on the evaluation of the aggregation mechanism*: Report with recommendations on evaluation of the aggregation toolset and pilot phase for data provider familiarisation with the technology.

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[1] Metadata Interoperability Platform provided by NTUA:
http://mint.image.ece.ntua.gr/redmine/projects/mint/wiki/Introduction_to_MINT

2   Metadata ingestion workflow in Europeana Sounds

2.1   Workflow

The aggregation workflow can be considered as a two-phase process, illustrated in Figure 1. The first phase is handled by MINT ingestion platform, and this is the part where data providers get involved in the aggregation process. In the second phase, transformed metadata are delivered to Europeana in EDM via OAI repository and are then transformed and published on the Europeana online portal.
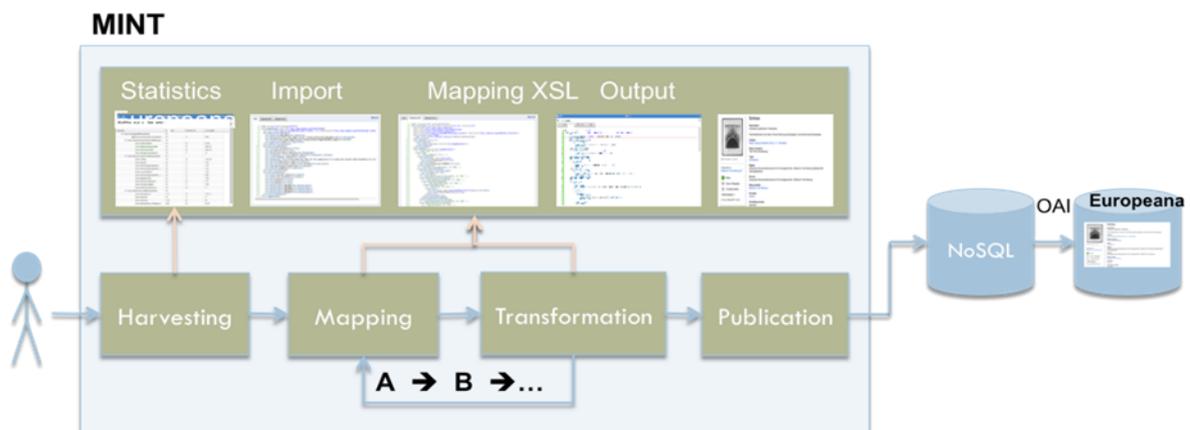

Figure 1: Overall workflow as a 2-step process

The MINT aggregation platform facilitates the ingestion of semi-structured data and offers the ability to establish crosswalks to the reference schemas (EDM Sounds profile, EDM) in order to take advantage of a well-defined, machine understandable model. The underlying data serialization is in XML, while the user's mapping actions are registered as XSL transformations.

Once data providers have exposed their metadata through the Europeana publication procedure in MINT, Europeana can harvest them from NTUA's OAI-PMH server into its system. Data are then transferred into Europeana's MINT where:

- Quality assurance is performed;

- Data are mapped and transformed from EDM External to the EDM Internal standard;

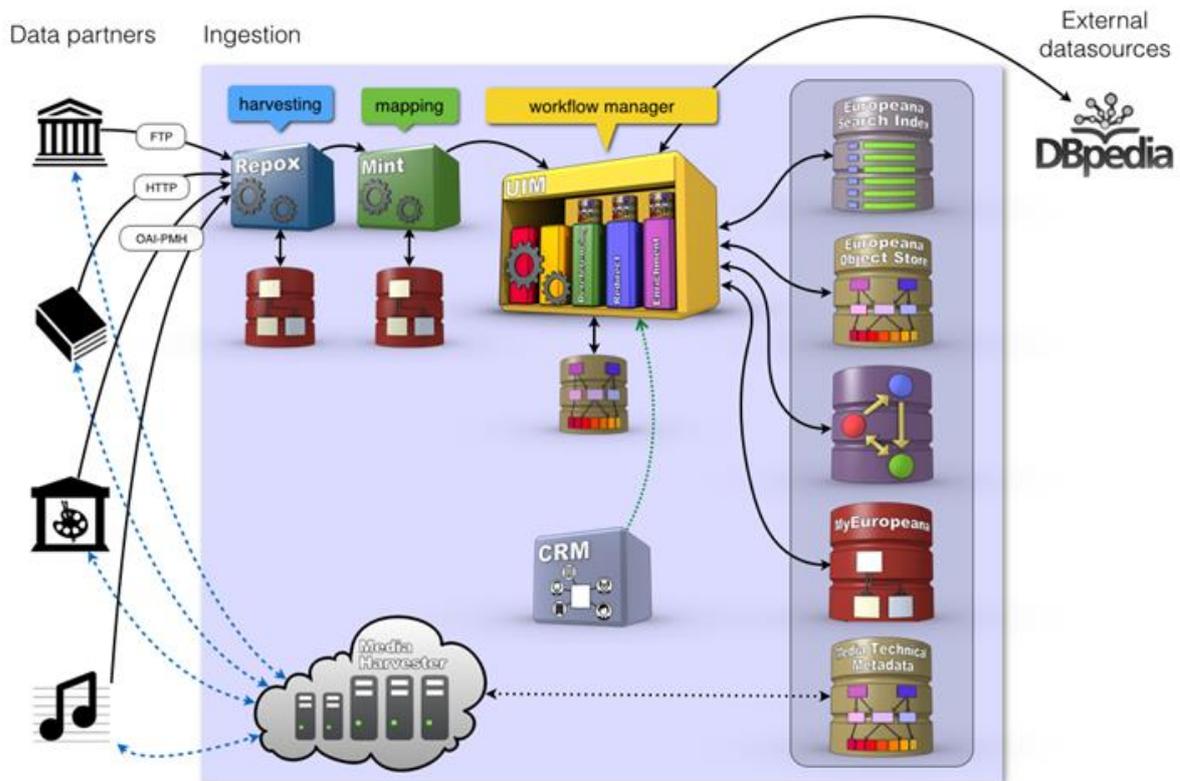- Validation is run according to the EDM Internal standard schema (XSD).

Figure 2: Europeana Ingestion Workflow

The transformed data are re-imported in UIM's Mongo database and a series of operations is triggered to enrich the data prior to their publication onto Europeana's portal and API: link caching, identifiers generation, redirects creation, enrichment. More details about the Europeana part of the workflow are presented in section 3.

3 MINT services

3.1 Description of basic aggregation functionalities in MINT

The main role of the MINT ingestion platform in the Europeana Sounds project is to enable users to:

- Provide metadata records in a range of "source" formats

- Convert metadata to selected target schema (EDM and EDM Sounds profile - used as an intermediate standard before publishing to Europeana)

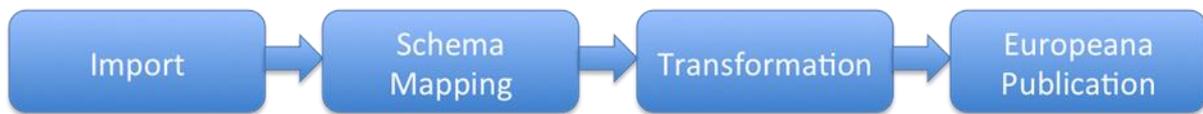- Monitor the progresses of data provision.

Figure 3: MINT Ingestion workflow

Metadata upload and preparation

Registered users are able to upload their metadata records in XML or CSV serialisation, using HTTP, FTP and OAI-PMH protocols. XML records are stored and indexed for statistics, previews, access from the mapping tool and subsequent services.

Metadata mapping

A graphical user interface assists data providers in mapping their metadata to the target schema, using an underlying machine-understandable mapping language. Furthermore, it provides useful statistics about the provider's metadata, supporting the share and reuse of metadata crosswalks and the establishment of template transformations.

Transformation, quality check and publication

During this phase metadata is transformed to the selected schema by using the mapping made in the previous step. In order to publish metadata to Europeana, data have to pass a number of quality checks. Structural validity, completeness of metadata elements, use of controlled vocabularies are among the checks that can be applied. State of the art technologies are used to allow for a reliable, scalable and portable messaging and processing system, used in and between different services. Metadata is published in XML, JSON or RDF according to the mechanism and usage.

After quality check, the transformed dataset is prepared for publication by consenting to the Europeana Data Exchange Agreement and setting appropriately the Europeana Rights label.

The Europeana publication procedure

During the publication phase metadata are transformed from EDM Sounds profile to EDM - according to the project requirements - and stored at NTUA's OAI-PMH server. Publication to Europeana is then performed by informing Europeana's Ingestion office to harvest metadata from the NTUA's server.

3.2   Specific updates of MINT for Europeana Sounds

The MINT ingestion platform has been previously used in Europeana related projects, making it by now one of the mature solutions for metadata handling and reuse. Even if the main aggregation functionalities of the MINT platform – that is the transformation of the metadata extracted from the provider's metadata management systems in various standards to a common metadata standard for the project – remains the same, necessary adjustments for the implementation within a given data-domain, and continued development from a service provider's perspective, are needed to meet the requirements and objectives of the Europeana Sounds project.

Backend reconstruction

A new module for processing the XML imports was implemented considering the experience gathered from previous usage of MINT as well as feedback from data providers. This new processing module is responsible for the itemization of the imported metadata.

EDM Sounds Profile implementation and deployment

The EDM sounds profile specification was designed and released under T1.3 *EDM profile*. Using the aforementioned specification NTUA implemented the actual schema in XSD, which was then deployed in MINT, in order to enable users to map their metadata into EDM sounds profile schema, which is the sound enriched version of EDM used as intermediate schema before publishing to Europeana.

Mapping (XSLT) from EDM Sounds to EDM

This mapping is completed automatically using the corresponding XSLT that was specifically implemented and deployed within MINT platform for this purpose.

SKOS vocabularies support

Specific to the sound content, these vocabularies have been designed and developed within WP1 task T1.2 *Ontologies* and reported in D1.3 *Ontologies for Sound*, in order to aid and enrich the metadata production and delivery to Europeana by the data providers. More specifically, a semantic repository was set up in which the SKOS vocabularies are stored. The communication of the MINT mapping tool with the SKOS repository was established using SPAQRL 1.1 to retrieve the vocabularies' terms based on the SKOS specification.

OAI publication

MINT enables crosswalks between EDM Sounds profile and EDM schema through a user-friendly interface. In addition, it provides validation services for both EDM Sounds and EDM metadata models together with preview interfaces, through which providers can *a priori* check how their metadata would look when published on Europeana, thus ensuring high quality metadata.

OAI

MINT OAI repository is capable of managing heterogeneous collections of metadata records while exposing services for mapping and transforming from one metadata schema to another. MINT implements the defined OAI-PMH verbs on top of the underlying, domain-specific data layer. For the needs of Europeana Sounds the insertion mechanism has been re-implemented allowing the use of more than one schema through MINT resulting in multiple OAI namespaces for the same organization. The new insertion mechanism is more sophisticated and permits the use of arbitrary schemas - in our case EDM Sounds and EDM metadata - and the OAI exposure under different or the same namespace - in our case EDM records ends up to rdf namespace while EDM Sounds records end up to EDM Sounds namespace .

Mapping functionalities

Advanced mapping functionalities were developed in order to assist the data providers to enhance their mapped metadata. Such functionalities are:

- The implementation of the negation for all the conditions used in conditional mappings.

- The implementation of the else statement for further completing the conditional mapping functionality of the tool.

- "Group by" functionality; some of the providers have metadata exports in schemas that do not have any hierarchical structure like MARC.

3.3 Technical Details

The technical details of the ingestion workflow for the underlying data serialization are in XML, while the user's mapping actions are translated into XSL transformations. The EDM Sounds profile functions as an anchor, to which metadata from various data providers can be attached and become, at least partly, interoperable. Further and more technical details are described in document: EuropeanaSounds-D5.2-Deployment-of-fully-functional-updated-aggregation-system-v1.0.pdf

4 Europeana Data Processes

4.1 Ingestion

Data are imported to Europeana servers using the open-source REPOX solution. REPOX can communicate with remote data repositories via a number of protocols, the ones primarily used being OAI-PMH, FTP, and HTTP. EDM data for the Europeana Sounds project are harvested in EDM using OAI-PMH and exposed on the Europeana OAI repository: http://uim-external-apps.isti.cnr.it:8080/repoxUI_Europeana/OAIHandler?verb=Identify

The harvested data are stored on REPOX's PostgreSQL database.

4.2 Data transformations

From REPOX's database, data are copied to Europeana MINT's PostgreSQL database. Operations performed in MINT are cleaning, mapping and validation operations.

Cleaning and quality checks (MINT)

A number of quality checks are performed using the preview and statistics functionalities of MINT: general structure of the provided EDM data, existence of unique and well-formed identifiers, and richness of the literal values. For the Europeana Sounds project, the quality assurance is also done

according to the data requirements specified by WP1. Extra attention is paid to the use of SKOS ontologies. When necessary cleaning is performed using advanced mapping functionalities.

Mapping, transformation, validation (MINT)

From EDM External, data are transformed to the EDM Internal variation of the schema. XSD and Schematron validation is performed and records that do not meet the validation are marked as invalid.

Itemization and Unique Identifiers Generation (UIM)

The transformed valid data produced are (re-)imported and stored into UIM's Mongo database. The process of re-importing triggers additional transformations on the data:

Itemization: the Europeana Sounds data make use of new EDM entities such as edm:Collection and in order to properly serve these data on the Europeana portal and API, a splitting process is needed to extract sets of interlinked EDM entities according to their semantic relationships and generate one item for each edm:ProvidedCHO entity.

De-duplication and unique identifiers generation: the uniqueness of each obtained item is checked within each collection and Europeana identifiers are created for the generation of permalinks to access the published records.

Preview caching (Media Harvester)

Most Europeana Sounds objects are submitted to Europeana including a link to a visual preview. Provided links are checked and analysed, previews are generated and stored to be made retrievable on both the portal and via the API.

4.3 Enrichment (UIM)

Dereferencing and vocabulary mapping

Specifically for the Europeana Sounds project, links to concepts from SKOS sounds related ontologies are included in the provided EDM data. Three ontologies used by the project were mapped from SKOS to EDM: Sounds genres, DISMARC genres and DISMARC formats.

The Europeana dereferencing plugin is triggered on the EDM sounds data, enabling:

- Queries using SPARQL on these three external datasets;
- Transformation of the SKOS relevant data into EDM and download of the result in a Mongo database;
- Multilingual enrichment of the EDM Sounds data: values from the contextual resource are added to the original object description.

Semantic enrichment

Europeana's current enrichment process is based on the AnnoCultor tool. Europeana enriches all provided data by creating links to contextual resources - places, concepts, agents and time periods. Named entities are found in records using a set of heuristics. Contextual information relating to these

entities, from external data sources, is appended to the original record in the form of EDM contextual classes. This information currently includes multilingual representation of the identified contextual entity, as well as links to similar contextual resources. For the moment, contextual information is gathered from such external data sources as: Geonames, for geographical places; DBPedia for people and concepts; Gemet for concepts; and Semium for time periods. The processed output is stored locally in a MongoDB database. The enrichment plugin, which implements the described process, is also responsible for creating the version of the record database and search index to be published later on the production environment.

Providers Profile

In this section, we provide an overall description of the data providers' average experience with MINT and other Aggregation workflows. It is described in more detail in document: D5.1-EvaluationOfTheAggregationMechanism

Some participants were more technically oriented having more advanced knowledge of technologies and on the other side there were people with more complete knowledge of metadata standards and schemas, while others demonstrate both technical and theoretical skills. Regarding XSLT knowledge, the majority of participants (97%) described their knowledge of XSLT is average (42%) to weak (45%) and only 3% has strong XSLT knowledge.

Regarding the usage of other transformation tools, methodologies and mapping tools, 27% of respondents skipped these questions. From the rest, 44% responded that they have never used such tools. Also 65.5% of the participants have previously taken place in other aggregation workflows such as API-OAI workflows.

Regarding users knowledge of metadata schema, the majority of participants seem to be familiar with the target schema (data model, field names etc.). Specifically, 58.5% describe their knowledge of metadata schema as very good.

To sum up, the vast majority of the respondents had a weak to average knowledge of XSLT and very little experience with other transformation tools. Only a few users have used other mapping tools besides MINT. Most users have not used other mapping tools before and their first mapping experience was with MINT within Europeana Sound project.

5 Aggregation Toolset Support

Europeana Sounds used Basecamp as the main platform for communication.

5.1 Basecamp platform

Basecamp is an online platform that facilitates user communication and provides basic project management tools. The main features include:

● User discussions, where users can share their experiences on the Aggregation Toolset or request for support.
● Text documents, or other files, when posted are available at all times.
● Project or user calendars along with 'to do lists', with descriptions, to organize and monitor the project's progress.

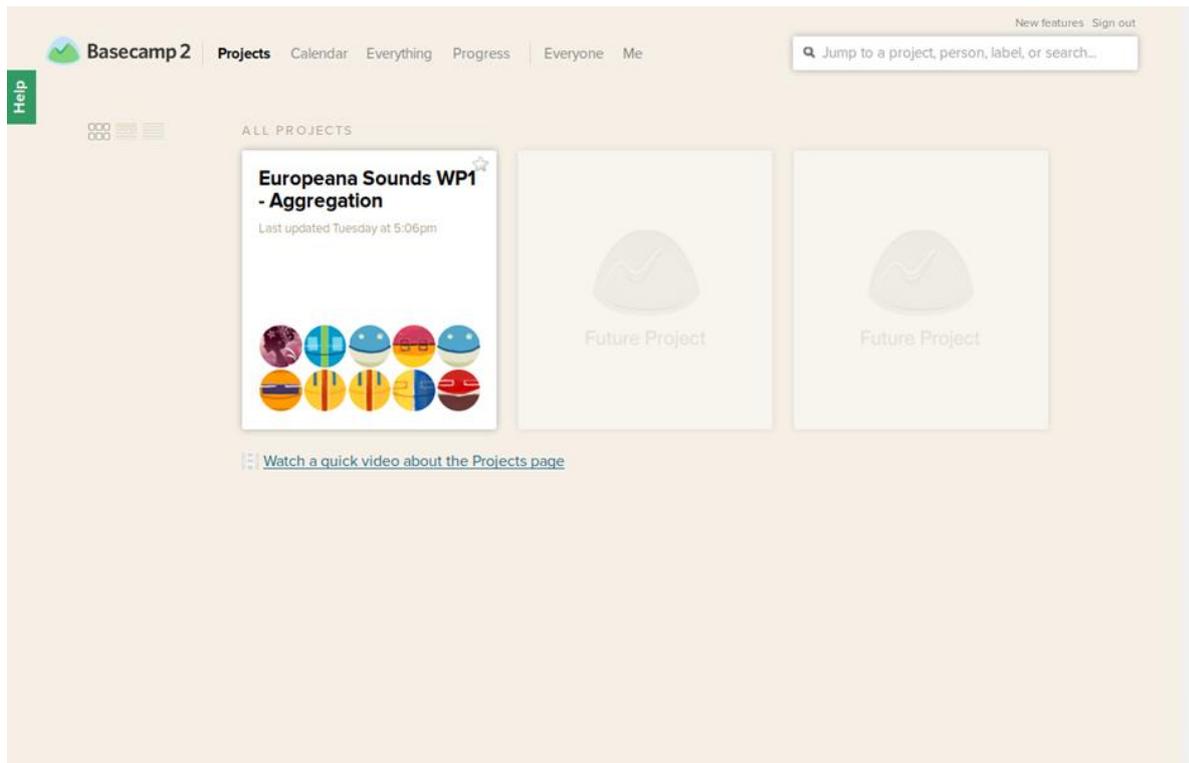The following screenshots give an overview of some Basecamp features:
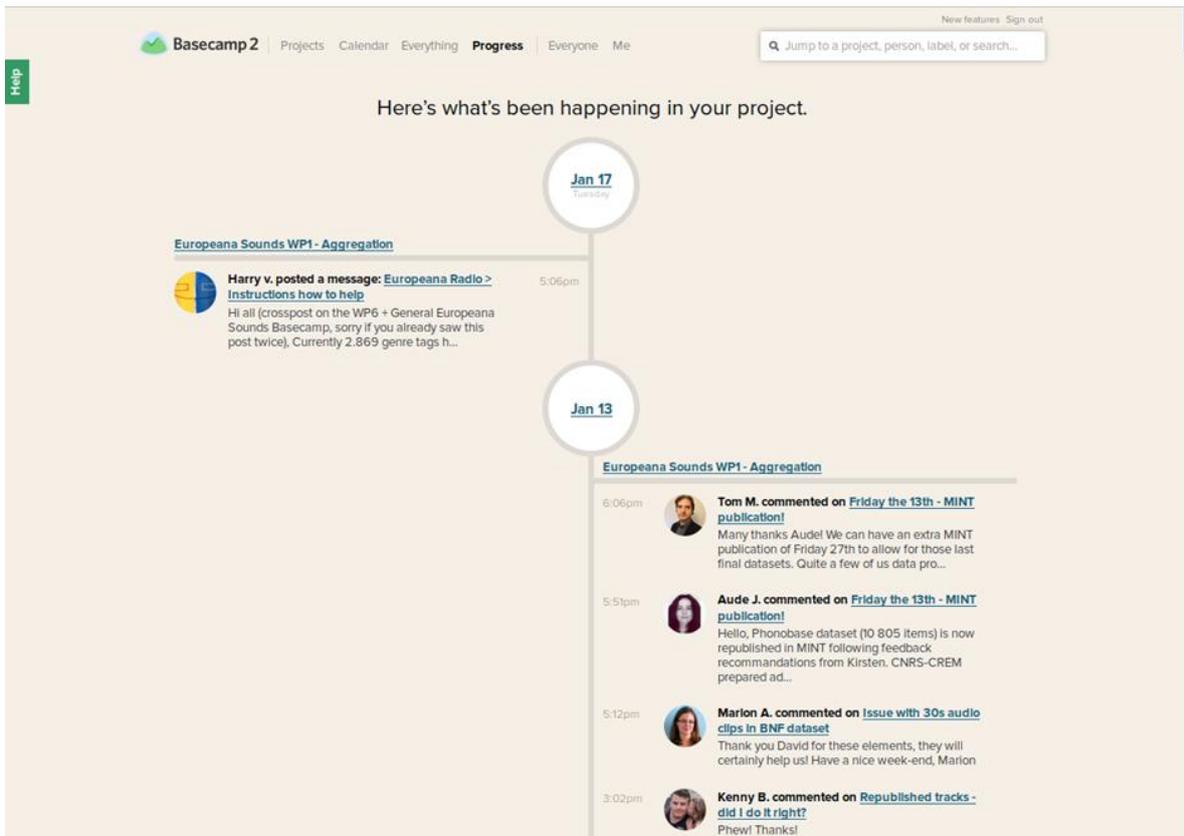

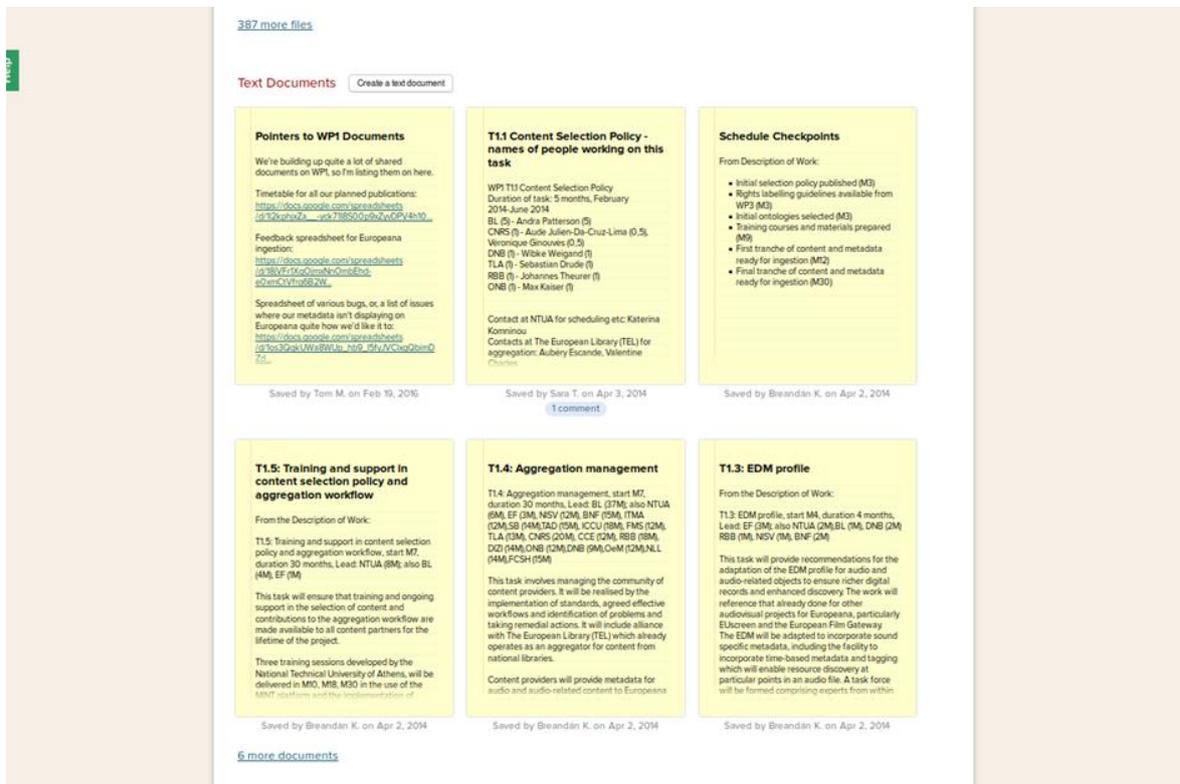**Figure 4: Basecamp project welcome**

Figure 5: Basecamp progress timeline

Figure 6: Basecamp text document uploads
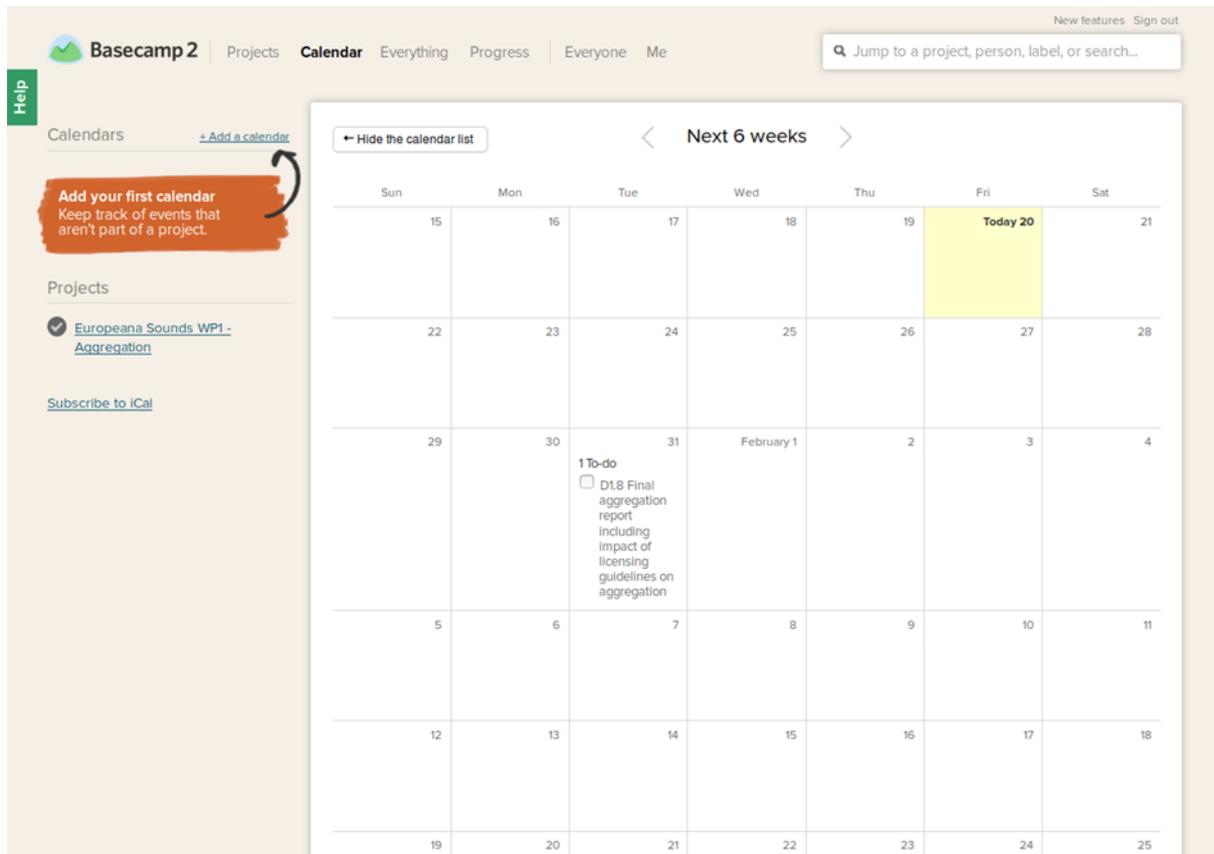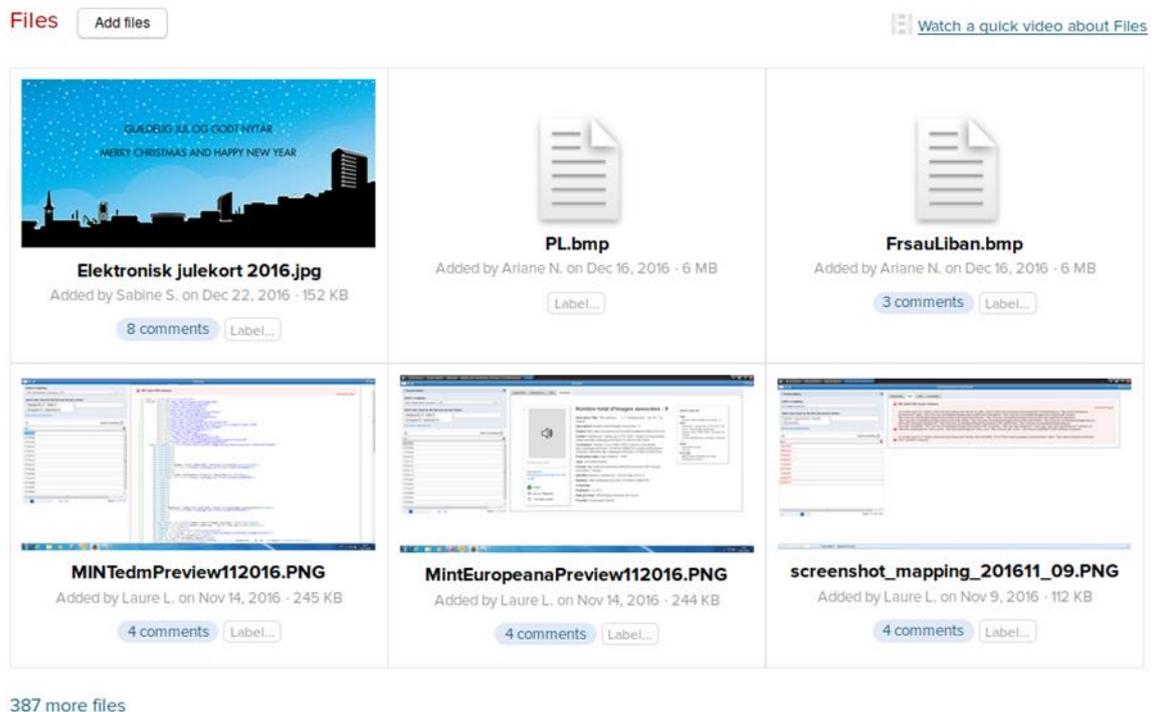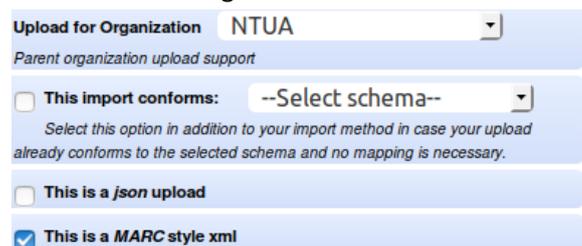
Figure 7: Basecamp shared calendar
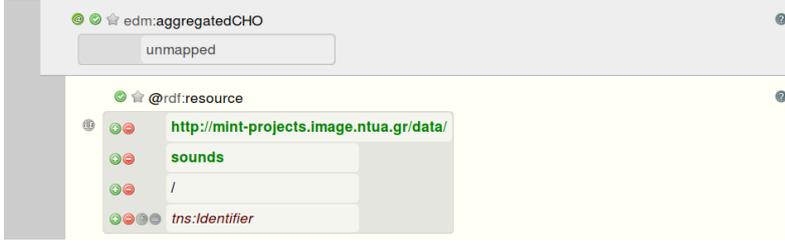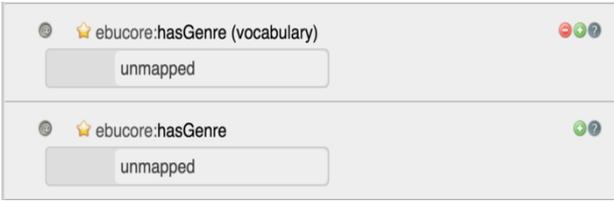

Figure 8: Basecamp File Repository

5.2 Basecamp discussions and support

During the aggregation process more than three hundred discussions were posted at the Basecamp site of Europeana Sounds (https://basecamp.com/1936492/projects/4984360/topics), providing useful answers to all users' questions and also important feedback about their experience using MINT and the Aggregation Toolset overall.

5.2.1 Examples of the discussions and support on Basecamp

In this section we describe the most frequent topics for support and discussion on Basecamp.

Subjects of discussion on Basecamp and support requests	Resolution
Requests to support special xml schema's for import in Mint. Marc Xml for example.	The corresponding functionality was added to MINT's import widget, as seen in this image:
A lot of questions were about mistakenly mapping url values to EDM literal values instead of the corresponding attribute field. For example the elements "edm:isShownBy" and "edm:isShownAt" where uri's need to be mapped in attribute "rdf:resource".	MINT provides a list of bookmarks at the Mapping Editor screen. Users were instructed to follow the Bookmarks list set in MINT for EDM mappings in order to map the mandatory elements correctly. Users were also informed through the discussions on how to map the url values to rdf:resource attributes.
The subject of many discussions was the use of hierarchies and elements and how to correctly map them. For example the elements l<edm:collection>,	Guidelines were described through the discussions and documents on how to structure these mappings. Specifically on how to map EDM objects identification attributes like "ProvidedCHO/@rdf:about", "Aggregation/aggregatedCHO/@rdf:resource"

<edm:isPartOf>, <edm: isGatheredInto>, <edm:isNextInSequence>.	
Many Basecamp discussions were about correctly using MINT's usage workflow.	Users were guided on using the Mapping Editor 's preview in a useful manner, in order to check for errors on mappings. Various MINT user interface features as Define Items, Download Dataset and Dataset Statistics , were explained further to users to help them make use of them Also the Mapping and Preview Transform and Publish workflow was often explained to users in order to publish their records successfully to EDM.
Plenty of the users questions were about using correctly MINT's mapping editor and the provided mapping options	Resolved by suggesting the use of a structural mapping in MINT's Mapping Editor. This solved a lot of issues when a mapping when mapping an element value, that exists in multiple xpaths with the same name. Various mapping issues were resolved after providing suggestions on the correct usage of conditional and concatenated mappings.
A few users question's subject was about the use of the vocabularies for example for the ebucore:hasGenre element.	Access to the thesaurus vocabulary was configured in MINT's mapping tool.
Specific input problems like url carrying empty spaces	Users were instructed to use MINT's Mapping editor to trim the corresponding values.
Special characters like ampersands '&' in xml were a common subject of discussions on basecamp.	Resolved after suggesting the correct use of the xml escape characters like '&'
Explanations were needed on the correct usage of SKOS vocabularies.	MINT's mapping editor provides access to multiple SKOS vocabularies. Advice was given through Basecamp's discussions and documents on using the MIMO and SKOS thesaurus. Further details can be found at : D1.3 *Ontologies for sound*

6   Summary

Europeana Sounds' aggregation workflow was implemented using the MINT platform, the Europeana Data Model - Sounds Profile specification (D1.4), and the Europeana Sounds Ontologies (D1.3). The operation of the aggregation was planned and monitored by WP1 in order to coordinate data provision (workflow guide, publication cycles, contingency planning etc. The technical infrastructure was implemented, monitored and maintained by WP5 in order to support the activities of WP1, implement the produced specifications and enable emerging ingestion and publication requirements. This document reports on the deployment of a fully functional updated aggregation system, contributing to task T5.3 *Aggregator deployment and maintenance* and uses the outcome of T5.1 *Aggregation infrastructure design* as well as experience obtained in T5.2 *Aggregation infrastructure evaluation*. The aggregation as described throughout the document was a two-phase process. The first phase was handled by MINT ingestion platform and was the stage where data providers get involved in the aggregation process. In the second phase, transformed metadata were delivered to Europeana in EDM via an OAI repository and then handled and published on Europeana's website.

The MINT ingestion platform has been previously applied in Europeana related projects, making it by now one of the mature solutions for metadata handling and reuse. Even if the base of the main aggregation functionalities of the MINT platform remains the same, necessary adjustments for the implementation within the given data-domain, and continued development from a service provider's perspective have been applied to meet the requirements and objectives of the Europeana Sounds project. All specializations applied to the MINT platform with respect to Europeana sounds project such as frontend and backend reconstruction, advance mapping functionalities, EDM sounds profile implementation and deployment, SKOS vocabulary support and OAI publication, are further described in this document. Additionally, the basic aggregation functionalities offered by MINT - metadata upload and preparation, mapping, transformation, quality check and publication – are presented.

During the aggregation process, technical support was constantly provided on the Basecamp platform. The providers sought support through Basecamp records of previous discussions, and posted files and documentation, or by posting a new question. All of the provider's requests were answered and resolved successfully by modifying the aggregation toolchain, or by adding new functionalities to it, and providing support and guidance individually to every provider request.

After the completion of the MINT aggregation services, there were a set of data processes that take place on Europeana's site before data publication on Europeana portal. These processes, as further explained in this report, include; ingestion, transformation, preview caching, enrichment and publication. By January 2017, more than 1.5 million Sounds objects were successfully aggregated and published in Europeana from more than 20 consortium data providers and from Associated Partners.

7   References

Ref 1	D1.3 – Ontologies for sound: the recommendations from work on ontologies and language.

	http://pro.europeana.eu/files/Europeana_Professional/Projects/Project_list/Europeana_Sounds/Deliverables/EuropeanaSounds-D1.3-Ontologies-for-sound-v1.2.pdf
Ref 2	D1.4 – EDM profile for sound: the result from the working group defining audio extensions to EDM. http://pro.europeana.eu/documents/2011409/5c845fc2-dcf7-46c2-a66d-6aea9dac1c0c
Ref 3	D5.2 – Deployment of fully functional updated aggregation system deployed by UIM http://pro.europeana.eu/files/Europeana_Professional/Projects/Project_list/Europeana_Sounds/Deliverables/EuropeanaSounds-D5.2-Deployment-of-fully-functional-updated-aggregation-system-v1.0.pdf
Ref 4	D5.1 – Report on the evaluation of the aggregation mechanism: Report with recommendations on evaluation of the aggregation toolset and pilot phase for data provider familiarisation with the technology. http://pro.europeana.eu/files/Europeana_Professional/Projects/Project_list/Europeana_Sounds/Deliverables/EuropeanaSounds-D5.1-Evaluation-of-the-aggregation-mechanism-v1.0.pdf
Ref 5	MS24 – Aggregation infrastructure prototype available – reports on the delivered prototype that offers aggregation services such as registration and metadata import, mapping and transformation, and publication
Ref 6	MS25 – Sounds SKOS ontology normalization and cleaning module beta – outlines advance functionalities of aggregation mechanism.
Ref 7	MS26 – Aggregation mechanism ready – reports on the delivery of the aggregation mechanism.

Appendix A: Terminology

A project glossary is provided at: http://pro.europeana.eu/web/guest/glossary.

Additional terms are defined below:

Term	Definition
APEX	Archives Portal Europe network of excellence
EC-GA	Grant Agreement (including Annex I, the Description of Work) signed with the European Commission
EDM	Europeana Data Model
PMB	Project Management Board
TEL	The European Library
WP	Work Package