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Summary

The aim of the OpenAIRE system is to harvest publication bibliographic metadata from institutional and subject-based repositories, e.g., Open Access Repositories (OAR), and in parallel to fetch project metadata from the CORDA database of the European Commision to enable ways for interconnecting the two, in order to identify, capture and measure the results obtained through EC fundings in FP7 projects.

This deliverable explores two main issues related with the above scenario: (i) the possibility for OpenAIRE to interoperate with existing CRIS-OAR environments, which already have started to establish similar principles and exchange mechanisms for an integrated research environment, and (ii) the methodology adopted and agreed by OpenAIRE and the CORDA database EC service to make the two systems interoperate on the logical level and develop services to ingest project information into OpenAIRE. More specifically, this document investigates two levels of interoperation with such external services:

CRIS-OAR interoperability: within the research information domain, arbitrarily two types of information systems may be distinguished:

- administrative information used for research management and accountability towards funders and generally contained in so-called Research Management Systems (RMS) or Current Research Information Systems (CRIS)[1];
- bibliographic information used in scholarly communication contained in (Open Access) Repositories (OAR), generally also containing the full-text publication.

In reality, CRIS systems are also capable of describing publications, but due to practical differences (CRIS's are run by the administrative departments of research organizations while OARs are run by library departments) a research institute's publications are maintained in the institution's repository. The emerging CRIS/OAR initiatives try to bridge the gap in the way publication information is presented and exchanged between the two information systems, in order to achieve results similar to the ones of OpenAIRE, but at the level of an institution or a larger organization, or even nation-wide: to assess the research output and ultimately define research funding criteria based on research merit. The Knowledge Exchange CRIS-OAR initiative aims at defining standard data models and data exchange formats specifically devised for describing and transferring content surviving in CRIS-OAR environments (i.e., publication bibliographical descriptions and related project information). This deliverable defines and proposes an XML schema for interoperability of CRIS-OAR environments, and based on this, it describes how the OpenAIRE data model can map onto it with the ultimate goal to be able to exchange information in the future.

CORDA interoperability: interoperability with CORDA is achieved at two levels of interaction, which are both addressed by this deliverable*:*

- establishing and implementing the protocols for data exchange, i.e., OpenAIRE system to consume CORDA database, and
- establishing a set of strict data access policies, in order not to *abuse* the data made available by CORDA database. This deliverable addresses both issues, by specifying the architecture and the established access rights.

[1] In this study we will use the term CRIS covering all systems that deals with contextual research information that not only covers bibliographic metadata like typically the repository does.

OpenAIRE and CRIS-OAR environments

Open Access Repositories and Current Research Information Systems are covering different parts and needs of the academic information domain, but in emerging integrated research environments where research executives need to make informed decisions basing their criteria on research output and impact, these systems also have converging information. However, the way possible synergies between the two types of systems are handled across Europe is highly heterogeneous, if handled at all. As a starting point, the Common European Research Information Format (CERIF - euroCRIS[2]) is a data model and exchange format for CRIS, an initiative that involves many key organizations in the research area management field. Aiming at overall interoperability and taking into account OAR requirements, it is trying to capture the essence of the integrated research environment and provides/promotes general and broad solutions to be adopted by CRIS systems in Europe. Even though CERIF covers in detail most aspects and current needs of a research environment, not many institutions or national organizations are fully CERIF compliant (different existing systems and information infrastructures, complexity of CERIF, local requirements, etc.), but are close and implement a *CERIF-like* model.

OpenAIRE will contain EC project data related to publications from research institutions that might be relevant for a university CRIS system to retrieve and import. Likewise, universities might have much more detailed information about the publications and related entities that could enrich the OpenAIRE information space.

In this study we will study different possibilities for importing to and exporting from OpenAIRE not only bibliographic metadata from repositories, but also contextual data from research management systems like CRIS', and more specifically CERIF-like systems.

We first present two short case studies which, based on the current research situations in Germany and Denmark, illustrate the variation and heterogeneity of the current systems and approaches. Next, we introduce the OpenAIRE data model and other relevant data models that are well known in the CRIS and OAR world, followed by a logical mapping between them and the OpenAIRE data model. Finally, we discuss the practical realization of importing and exporting methods based on the defined XML exchange formats.

1.1 Case studies

The following two short cases provide evidence that the systems landscape in Europe for CRIS and OAR interoperability is highly heterogeneous. Whether the metadata are standardized, and therefore highly structured and homogenous like the Danish case, or heterogeneous and decentralised like the German situation, there is potential added-value to be harvested by building a bridge between the research information kept in CRIS systems and the full-text kept in the repositories.

1.1.1 Germany

A recent case study from the Knowledge Exchange initiative (KE)[3] indicates that the German research information landscape is fairly fragmented, which translates into a heterogeneous, decentralised infrastructure that suffers from the lack of standardisation.

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[2] http://www.eurocris.org
[3] http://www.knowledge-exchange.info/Default.aspx?ID=340

Although an uptake may be observed due to increased demands for research assessment and accountability in the spending of public funds, the study states that the use of CRIS systems is not yet widespread. Most systems are the result of in-house development and are not harvestable, while at the same time lacking the level of granularity in bibliographic metadata necessary for the interoperability with OAR.

According to a survey conducted for the DRIVER II[4] project, Germany has a considerable number of institutional repositories. The repositories are generally loosely coupled with other academic information services within the local institution. Both this survey as the KE study indicate these only expose a subset of the total research output as Open Access publications.

1.1.2 Denmark

The Danish case study from KE shows a centralised, homogeneous landscape that is highly standardised, both at the information as well as the application level. The infrastructure aggregates information at a national level in the Danish National Research Database, where results are transformed in indicators which are subsequently used in research assessment and accountability of funds.

The Danish tradition in the collection and presentation of research information has led to a widespread use of CRIS based around two standard applications, PURE and Orbit. The information contained in the systems is exposed in the DDF-MXD common exchange format and harvestable through the use of OAI-PMH, which is also found on most popular repository applications.

The study indicates that since libraries and librarians have led the development of the national research database, there is no real division between CRIS and OAR. In fact the use of dedicated repository software is now limited to only two universities that are using DSpace. These repositories are to be tightly integrated with PURE, but the exposure of data to the national research portal continues through the harvesting of the CRIS.

1.1.3 Introducing an approach for linking research information systems

From the two case studies above it becomes clear that there are various degrees to which CRIS and OAR have been integrated, both at a local and at a national level.

The goal of OpenAIRE to join these two types of information systems, requiring CRIS/OAR interoperability in a heterogeneous information infrastructure, calls for a very simple yet flexible data model and exchange format. This will allow capable systems to supply OpenAIRE with very rich and granular information, while at the same time provide less sophisticated systems the opportunity to join without the need to heavily invest in both their capabilities as well as content upfront. Using this approach, OpenAIRE is able to benefit from the information from as many sources as possible and vice versa, allowing for a gradual enhancement of the data being exported or imported.

1.2 Logical Mapping

The OpenAIRE data model describes the integrated information space of projects and publications by introducing entities for *project*, *person*, *organisation* and *results*, in a similar approach as the CERIF reference model. A logical mapping between the two models was initiated to show how OpenAIRE can interoperate with CERIF compliant CRIS systems and actually exchange data. However, in an heterogeneous systems landscape like Europe's, the

[4] http://dare.uva.nl/aup/en/record/316871, http://dare.uva.nl/aup/en/record/316870

application and adoption of CERIF in its entirety still poses a steep learning curve for the non-CERIF based CRIS' and OAR's, which has lead to its partial adoption. Instead, we will focus on the mapping of OpenAIRE to the KE CRIS/OAR model designed to exactly cover this gap, by offering a light weight approach based on metadata exchange format and a set of vocabularies that is publication centric and therefore recognisable by repository managers.

1.2.1 OpenAIRE data model

The OpenAIRE data model is the model used for the administration of information maintained and presented in the OpenAIRE infrastructure. The model has been centred around four core entities: *projects*, *persons*, *organisations* and *results*. These four entities are interlinked through the *authorship* and *participant* entities as illustrated in the following figure:

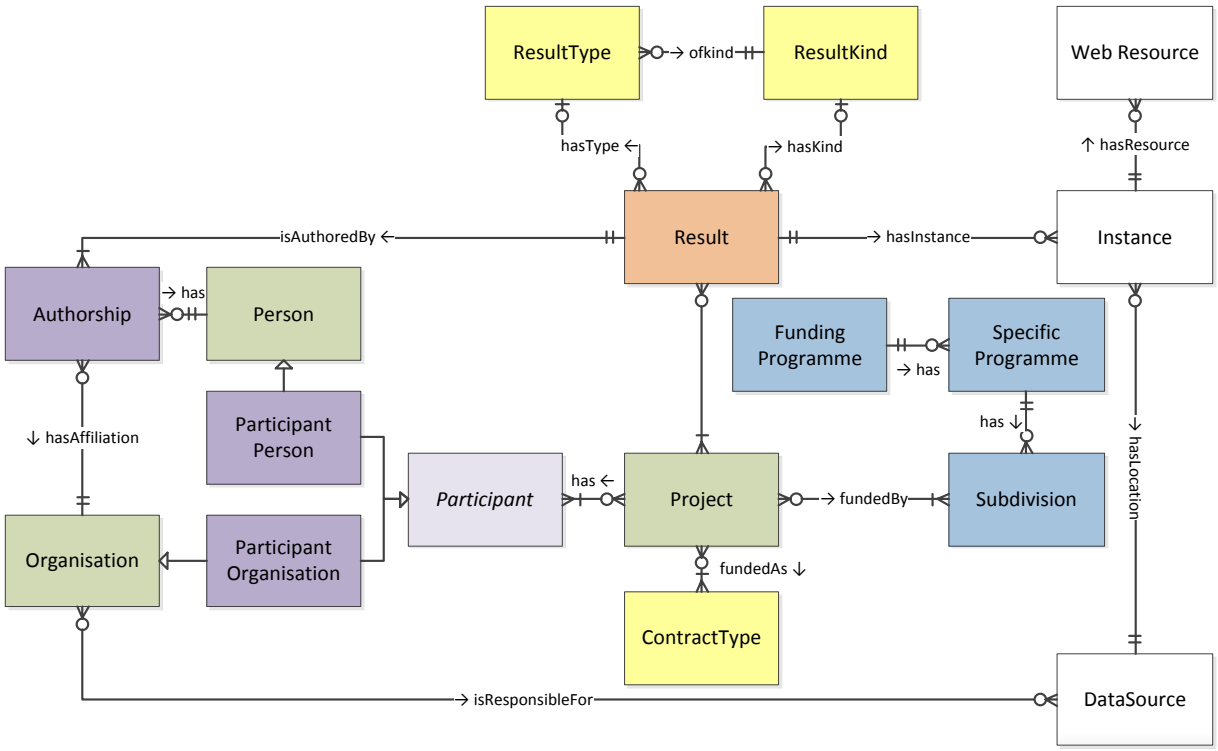

Figure 1: OpenAIRE entity model

Authorship is the relation between a *person* and a *result,* and optionally between the *organisation* the person was affiliated to at the times of production of the associated result.

The *participant* entity is an abstract entity that links either a concrete *person* or a concrete *organisation* to a *project.*

In addition, there are three entities associated with the funding model of FP7: *funding programme, specific programme* and *subdivisions* under which the various *projects* are funded.

A more detailed specification of the OpenAIRE data model, may be found in the OpenAIRE Data Model Specification project deliverable (Manghi 2010).

1.2.2 CERIF based KE CRIS/OAR data model

The Common European Research Information Format (CERIF) is a data model and exchange format for CRIS maintained by euroCRIS. Like the OpenAIRE data model, it is centred on *projects*, *persons*, *organisations* and *resultpublications,* including their mutual relations.

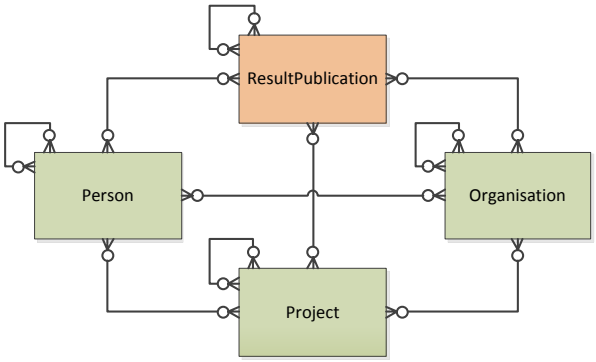

Figure 2: CERIF entity model

It provides a standardised database schema and associated XML serialisation. The model allows for very rich information with an added semantic layer. The addition of a semantic layer however introduces additional complexity on an already complex model, thereby, making it harder to define an interoperability mapping with third-party applications. Furthermore, the model is biased towards CRIS systems and requires a considerable amount of workload to implement this. As the case studies show, the reality of the heterogeneous European research information infrastructures call for an flexible and lightweight approach.

Within Knowledge Exchange, work is carried out to devise a simple yet flexible, unbiased syntax to allow for the exchange of information between CRIS and OAR systems. The syntax is based around the core entities of CERIF with the addition of *events*, which is present in CERIF, though classified as a second level entity.

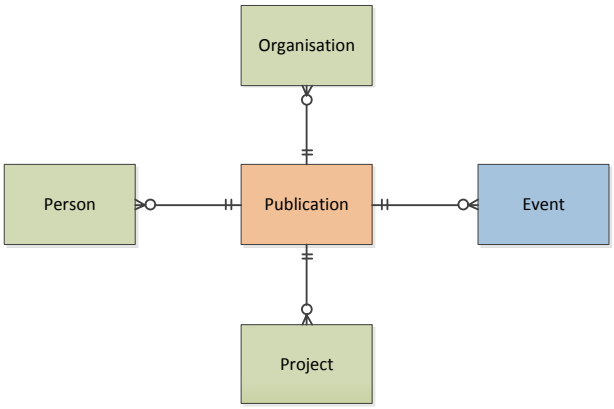

Figure 3: KE CRIS-OAR entity model

The model is centred on the publication entity. Within each instance of the publication, the relations between person, organisation, project and event are implicit. It is apparent that this model allows for a more pragmatic approach and that implementation of this exchange format is more feasible than implementing the CERIF Data Exchange Format Specification within the current state of Open Access Repositories and CRIS' in Europe and in the scope of OpenAIRE.

The underlying KE data model is in its core aligned with CERIF, hence CERIF compliant systems should be able to import the CRIS-OAR interoperability format without loss of information in relation to the OpenAIRE data model.

1.2.3 Mapping of Entities and Relations

The following mapping (figure 4) represents the high level mapping of the core KE CRIS/OAR entities (*person*, *publication*, *organization* and *project*) with the OpenAIRE data

model. Following the high level mapping is a tabular mapping of the single entities in the OpenAIRE data model with the KE CRIS/OAR exchange format.

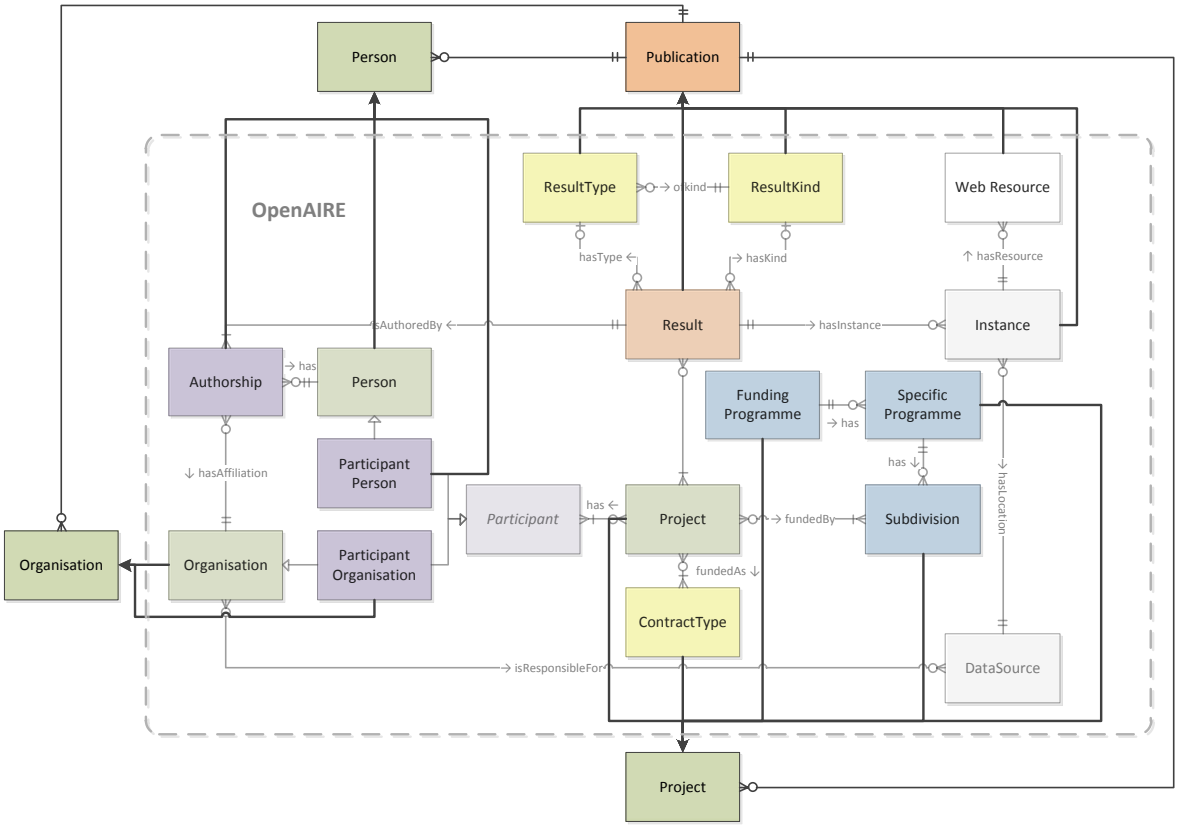

Figure 4: High level overview of the mapping

OpenAIRE entity	KE CRIS-OAR entity	Comments
Person	-	
Project	Project	
Organisation	Organisation	
Result	Publication	
Authorship	Person (creator)	
Participant	-	Abstract entity which will not be mapped.
ParticipatingPerson	-	
ParticipatingOrganisation	-	
FundingProgramme	Project (funder/programme)	
SpecificProgramme	Project (classification)	
Subdivisions	Project (classification)	
ContractType	Project (classification)	

ResultKind	-	The KE CRIS-OAR only deals with results of kind "publication".
ResultType	Publication (type)	
Instance	Publication (identifier)	
Web Resource	Publication (identifier	
Data Source	-	Out of scope. Should be meta information acquired from harvester or administrative interface.

Person Members

Unless the person is referenced as an author, the entity should be of type contributor.

OA: Person member	KE CRIS-OAR path	Comments
Name	//person/contributor/name/last	
Surname	//person/contributor/name/first	
Nationality	//person/contributor/nationality	

Project Members

OA: Project member	KE CRIS-OAR path	Comments
Web Site	//project/relation/identifier/uri	
Grant_Agreement_Number	//project/relation/funder/identifier/uri	
Acronym	//project/relation/title/ancronym	
Title	//project/relation/title/main	
Start_date	//project/relation/start	
End_date	//project/relation/end	
Keywords	//project/relation/subject/keyword	

Organisation Members

OA: Organisation member	KE CRIS-OAR path	Comments
Legal Short Name	//organisation/contributor/name/acronym	
Legal Name	//organisation/contributor/name/level1	
Web Site URL	-	
Logo URL	-	
Country of Origin	//organisation/contributor/address/country	

Longtitude, Latitude, TimeZone	-

Result Members

OA: Result member	KE CRIS-OAR path	Comments
Title	//publication/title/main	
Date of Publication (optional)	//publication/date[type='published']/value	
Description	//publication/description/abstract	
Publisher (optional)	//publication/publisher	
Language	//publication/language	
Access Mode	//publication/identifier/access	
Embargo end-date (optional)	//publication/date[type='embargo']/value	
Keywords	//publication/subject/keyword	

Authorship Members

The authorship entity should be viewed as a person, but then of type creator and not contributor.

OA: Authorship member	KE CRIS-OAR path	Comments
-	-	

Participant Person Members

OA: Participant Person member	KE CRIS-OAR path	Comments
EC_participant_number	//person/contributor/id[type='eu number']/id	
Name	//person/contributor/name/last	
Surname	//person/contributor/name/first	
Nationality	//person/contributor/nationality	

Participant Organisation Members

OA: Participant Organisation member	KE CRIS-OAR path	Comments
EC_participant_number	//organisation/contributor/id[type='eu	

	number']/id
Legal Short Name	//organisation/contributor/name/acronym
Legal Name	//organisation/contributor/name/level1
Web Site URL	-
Logo URL	-
Country of Origin	//organisation/contributor/address/country
Longtitude, Latitude, TimeZone	-

Funding Programme Members

OA: Funding Programme member	KE CRIS-OAR path	Comments
Identifier	//project/relation/funder/identifier/uri	
Name	//project/relation/funder/funder_scheme/programme	
Acronym	//project/relation/funder/name/acronym	

Specific Programme Members

OA: Specific Programme member	KE CRIS-OAR path	Comments
Identifier	//project/relation/subject/classification[@source='info:eu-repo/openaire/specificprogramme']	
Name	-	(Re)Solve in the presentation layer of OpenAIRE.
Acronym	-	(Re)Solve in the presentation layer of OpenAIRE.

Subdivision Members

OA: Subdivision member	KE CRIS-OAR path	Comments
Identifier	//project/relation/subject/classification[@source='info:eu-repo/openaire/subdivision']	
Name	-	(Re)Solve in the presentation layer of OpenAIRE.

Acronym	-	(Re)Solve in the presentation layer of OpenAIRE.

Contract Type Members

OA: Contract type member	KE CRIS-OAR path	Comments
Identifier	//project/relation/subject/classification[@source='info:eu-repo/openaire/contractType']	
Name	-	(Re)Solve in the presentation layer of OpenAIRE.

Result Kind Members

OA: Result Kind member	KE CRIS-OAR path	Comments
Name	-	Publications are the only supported kind.

Result Type Members

OA: Result Type member	KE CRIS-OAR path	Comments
Name	//publication/type/publicationType	

Instance Members

OA: Instance member	KE CRIS-OAR path	Comments
URI	//publication/identifier[type!='url']/uri	

Web Resource Members

OA: Web Resource member	KE CRIS-OAR path	Comments
URL	//publication/identifier[type='url']/uri	

Data Source Members

The information that is represented by the data source entity strictly isn't research or bibliographic information. Therefore it is considered out of scope for this model as there will likely not to be any CRIS or OAR systems that supply this kind of information.

OA: Data Source member	KE CRIS-OAR path	Comments
Official name	-	
English name (optional)	-	
Web Site URL	-	
Logo URL	-	
Contact email	-	
Longtitude, latitude, TimeZone	-	
Typology	-	
Access Info Package	-	

1.3 Realizing import/export of project/publication data from/to OpenAIRE

The OpenAIRE portal will contain information about entities such as organisations, projects, persons and publications in relations to FP7 granted projects (see figure 1). CRIS in universities and funding institutions will typically contain similar information.

In the context of OpenAIRE not only the entities are of special interest but also their connections and relations. The OpenAIRE guidelines present a low barrier approach for participating data providers to submit relevant FP7 research results to the OpenAIRE portal or vice versa. However, interesting potential and synergy may be achieved if detailed data from systems like CRIS are provided in a format that can represent the different related entities, like the KE CRIS-OAR.

In the following we will give recommendations for a metadata package format and a transfer method in order to export and import data between current research information systems and the OpenAIRE portal.

1.3.1 Exchange format – MPEG-21 DIDL as the Recommended Metadata Package Format

The MPEG-21 Digital Item Declaration (MPEG-21 DIDL) is an approach for the representation of digital assets in XML. It defines an abstract model of entities and a serialization of this format in XML – the Digital Item Declaration Language (MPEG-21 DIDL)[5]. Although originating in a community focusing on the coding of audio and video it has also proven its applicability for compound documents in the context of institutional repositories (Bekaert

[5] http://mpeg.chiariglione.org/standards/mpeg-21/mpeg-21.htm

2003)[6]. E.g., an MPEG21 DIDL Application Profile for Institutional Repositories was developed by SURF as a solution for the representation and harvesting of compound digital resources (doctoral theses that consist of multiple digital resource files) from local repositories by service providers[7].

With the help of DIDL it is possible to wrap *complex* documents with heterogeneous entities and metadata formats together in one package.

Representing different views on the information space

In the context of OpenAIRE, MPEG-21 DIDL allows us to wrap a publication and its related entities: Person, Project, Organisation and Event (figure 5: publication view).

In addition, MPEG-21 DIDL is highly flexible, which allows the representation of different views of the information space and wrapping the related entities into a single XML envelope. Of particular interest to OpenAIRE are Publication (Figure 5) and Project (Figure 6) views, however other views would be possible only limited by the main entities in the exchange format i.e., Person, Event, Organisation.

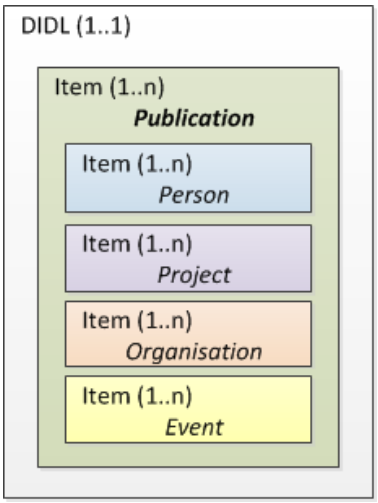

Figure 5: Publication view

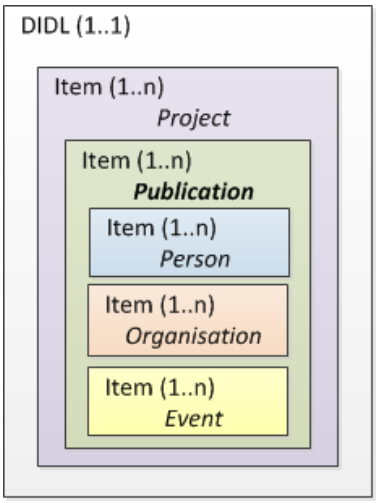

Figure 6: Project view

As illustrated in figure5 the DIDL document starts with a DIDL root element. It contains one top-level Item element, which can have Item child elements of cardinality given in the straight brackets. The specific type and identifier of each Item element is described in Descriptor/Statement constructs.

In this package the different entities as `Items` are implicitly related to each other and the relations are declared by the roles of the entities, i.e., Olsen, SI *is author [Person A has role="author"] of Conference paper [Paper B is type="conference paper"] which is a result of research EC FP7 project [Project C is type="research", identifier/type/Grant agreement number identifier/uri/214148] presented at Conference [Event D type="conference"]*. Thus

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[6] http://www.dlib.org/dlib/november03/bekaert/11bekaert.html, check up reference.

[7] http://wiki.surffoundation.nl/display/standards/MPEG21+DIDL+Application+Profile+for+Institutional+Repositories

the DIDL package can be used in the context of importing/exporting publications and their relating entities to and from the OpenAIRE information space. A elaborate real-life example is given in appendix B.

1.4 Export methods

Research information packages can be transferred between OpenAIRE and CRIS applications by various means. This chapter focuses on OAI-PMH for the harvesting of XML metadata packages, OAI-ORE for describing the packages as aggregation of web-resources and FTP for the transfer of xml metadata files. Their use depends on the particular application scenarios and the available interfaces of the systems involved.

1.4.1 OAI-PMH

The Open Archives Initiative-Protocol for Metadata Harvesting (OAI-PMH)[8] is widely used for exchanging structured metadata between data providers and service providers. In OpenAIRE this method is already designed for the harvesting from OAI-PMH compliant repositories that expose their metadata according to the OpenAIRE guidelines[9]. With reasonable effort, this method can be applied also to the exchange of research information from CRIS applications to OpenAIRE and vice versa.

Since an OAI-record can be disseminated in multiple metadata formats, the desired metadata schema must be configured accordingly. This enables to test the validity of the metadata.

In case of exposing DIDL encoded records the data provider must apply the following parameters:

- The `metadataPrefix` must be agreed and shared in the community of data providers exposing the DIDL-KECrisOar packages, e.g. `metadaPrefix = 'kecrisoar_didl'`.
- The metadata `schema` defines the URL of the schema:
  `schema = 'http://purl.lanl.gov/STB-RL/schemas/2003-12/DIDL.xsd'`
- The XML namespace URI is the global identifier of the metadata format and must be set as
  `metadataNamespace= 'urn:mpeg:mpeg21:2002:02-DIDL-NS'`

The KE-CRIS-OAR entities are wrapped in a DIDL container which is subsequently packaged in a single OAI-record in its metadata segment. This includes the entity "publication" as a top level item and all relative entities (project, person, organization and event) as sub level items of the "publication".

[8] last visited 29.09.2010: http://www.openarchives.org/pmh/
[9] last visited 28.09.2010:
http://www.openaire.eu/attachments/067_OpenAIRE-Guidelines_v1.pdf

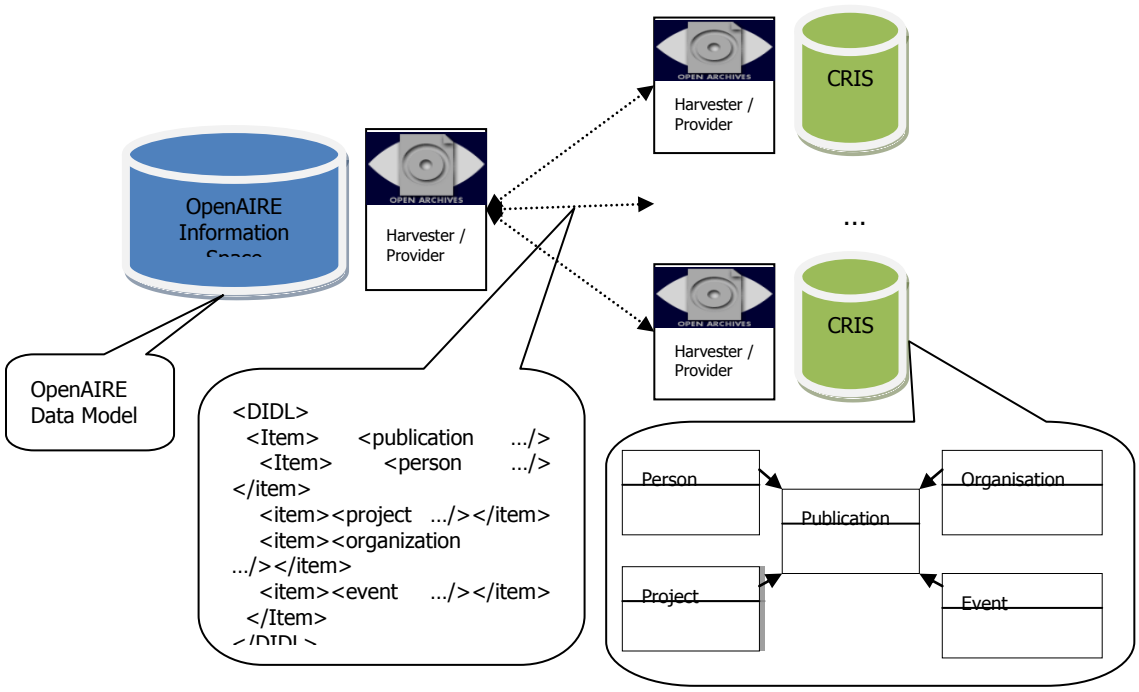


Figure 7 OAI-PMH metadata transfer between OpenAIRE and CRIS

Furthermore OAI-PMH allows data providers to group their records into predefined `setSpec` elements that indicate the membership of a record. Within the task of interoperability, the definition of sets is a feasible option to identify and exchange metadata of publications and participants that is relative to different projects between OpenAIRE and CRIS. Since OAI sets can be uniquely referenced by the grant agreement number, regardless of how extensive the underlying contextual information is, a set-specific approach enables selective harvesting.

A `setSpec` is accompanied by a `setName` and an optional `setDescription`. A `setSpec` should be made up by a prefix designating an EC-funded project (grant agreement number). The prefix shall be followed by the ID.

setSpec	setName	setDescription
ga_246686	openAire	optional text describing the project

The specific content of a set is to be determined at the local CRIS. If no content about a particular EC project is available at the local level, no according set should be provided.

1.4.2 OAI-ORE

The Open Archives Initiative – Object Reuse and Exchange (OAI-ORE)[10] follows a Web centric approach. It defines standards for the description of Web Resources as aggregations.

[10] last visited 09.11.2010: http://www.openarchives.org/ore/

Those descriptions will be serialized and exposed as Resource Maps, e.g. in RDF/XML and can be exchanged between applications.

The essence of the ORE model is the introduction of two new Resources. The first – called Aggregation – is a collection of other Resources – called Aggregated Resources. The second – called Resource Map – provides information about the Aggregation. All resources have URIs assigned.

Thus in the context of CRIS-OAR, the OAI-ORE will provide its full potential if all CRIS-OAR entities can be localized by their URIs.

Two scenarios will be described:

1. The publication as an aggregation of its full-text, metadata encoded in KE-CRIS-OAR and aggregated resources, namely Project, Person, Organization and Event. They can be itself aggregations of their relative entities.

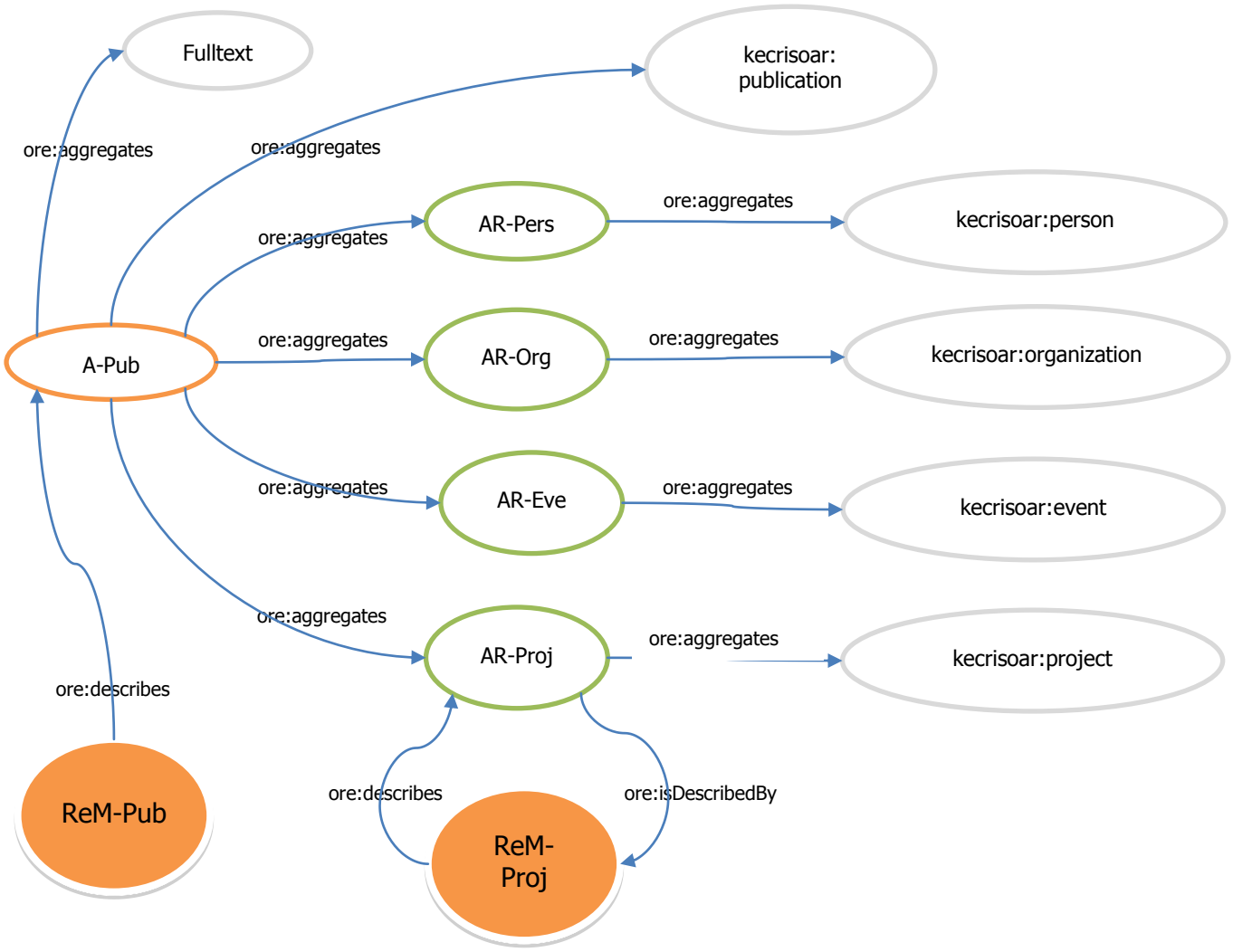


Figure 8 simplified OAI-ORE model of a publication as an aggregation of CRIS-OAR entities

2. The nested aggregation is an aggregation of the collection of all publications. Each aggregated publication is itself an aggregation of its metadata and entities of Project, Person, Organization and Event.

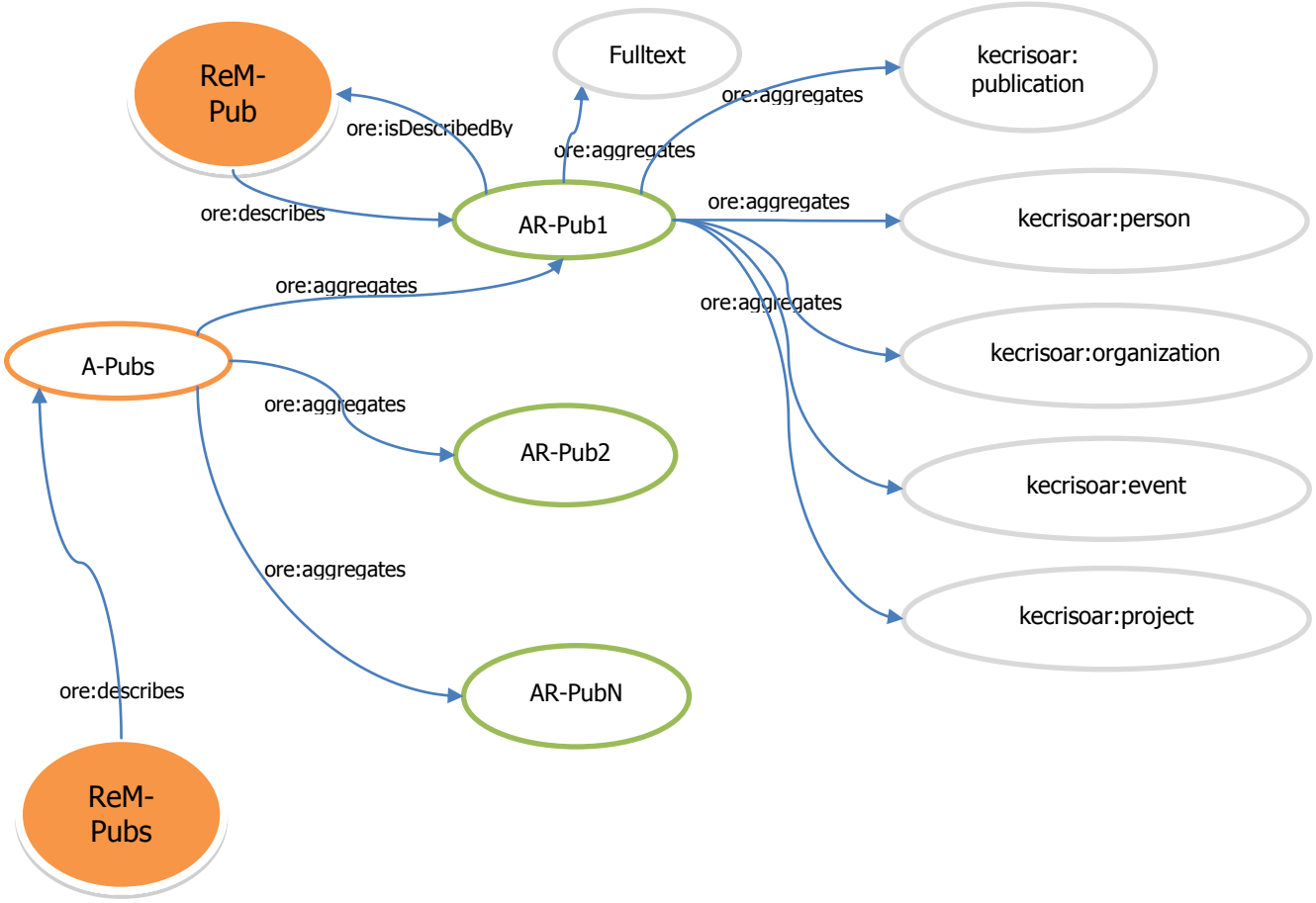


Figure 9 simpliefied ORE model of a nested aggregation of publications

Table 1 Legend

A-Pub	ore:Aggregation of a publication
AR-Pub	ore:AggregatedResource of a publication
AR-Pers	ore:AggregatedResource of a person
AR-Org	ore:AggregatedResource of an organization
AR-Eve	ore:AggregatedResource of an event
AR-Proj	ore:AggregatedResource of a project
ReM-Pub	ore:ResourceMap of A-PUB
ReM-Proj	ore:ResourceMap of AR-Proj
A-Pubs	ore:Aggregation of a collection of Publications

ReM-Pubs	ore:ResourceMap of A-Pubs

1.4.3 FTP

The File Transfer Protocol (FTP)[11] allows the interactive transfer of files of arbitrary type. The naming of files and directories, the type and content of the files are subject to a convention between the client and server.

Then a scenario for the collection of publications is described:

- The CRIS application provides a FTP server.
- On a regular basis (e.g. a weekly interval) it creates a DIDL document.
- It queries the local database for research information and encodes the results in the KE-CRIS-OAR format. For every publication metadata it creates a *kecrisoar: publication* item in the DIDL container. For each such item the relative project, organization, person and event entities are added as sub level items.
- The OpenAIRE FTP client then retrieves a single DIDL document structured by all publication entities with their related CRIS-OAR entities.

1.4.4 Comparing the standards

The following table summarizes conceptual and architectural features of the export methods.

Criteria	OAI-PMH	OAI-ORE	FTP
Concept	relies on XML metadata records	relies on aggregation of URI resources	relies on files of arbitrary type
Protocol Layer	HTTP REST-like	HTTP RESTful	FTP
Identifier	OAI record identifier for the package Constituents are not addressable individually	each constituent has an URI and is addressable	name of the metadata file
Addressability	the record only	each resource	The file containing the package

[11] last visited 09.11.2010: http://tools.ietf.org/html/rfc959

Interaction with CORDA, the European Commission databases

This chapter addresses the two main challenges involved in the interaction between OpenAIRE system and EC CORDA database. It describes which data the OpenAIRE system needs to retrieve from the EC CORDA database to accomplish its mission and what is the intended usage of this data once inside the OpenAIRE system. For the sake of clarity, the document first introduces the OpenAIRE data model from a high-level perspective, focusing only on the project information schema and ruling out the "publication" modeling aspects. Second, it presents the corresponding relational schema, whose table and fields should find a correspondence in the CORDA database. For such tables the intended usage of each field is specified and is intended to be a formal request for authorization. Finally, it describes the software architecture, protocols and policies established to enable continuous communication and update of information between CORDA and OpenAIRE.

1.5 OpenAIRE High-Level Data Model: handling projects information

The OpenAIRE project information data model is the result of a "reverse engineering" process of the information found on the CORDIS Web Site and a discussion with CORDA representatives, held in Brussels (29th of September 2010). The Entity-Relationship model is shown in Figure 10. As illustrated, a Participant is meant to be a formal beneficiary of funds from a Project. It is uniquely identified by an *EC participant number*, assigned at the time the participant is granted the project by the EC (note the "coordinator" of the project is always assigned number "#1"). A Participant is always associated to the relative Project, to the Organization it represents, and to the contact Person of such Organization.

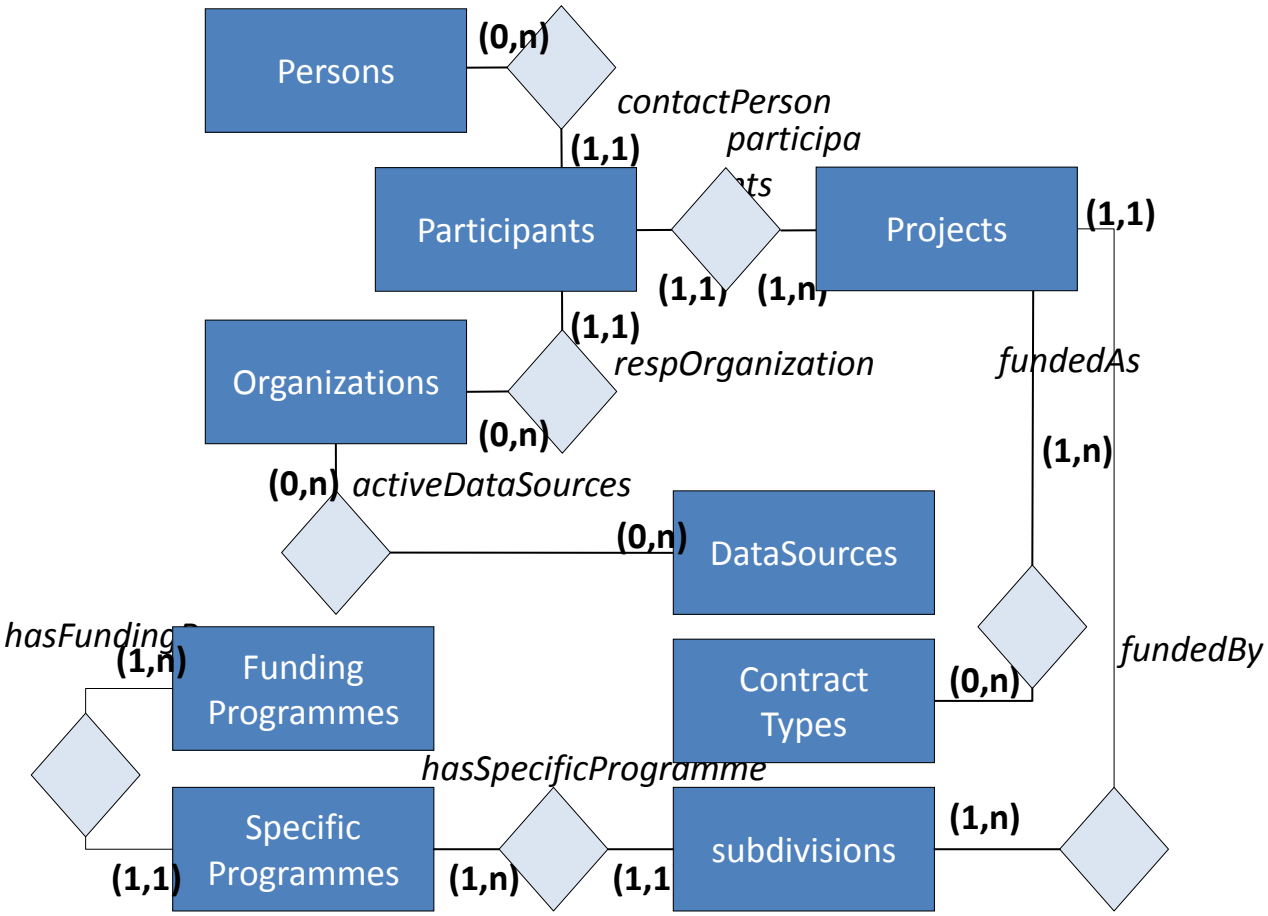


Figure 10 – Entity-Relationship schema: Project data

Representative examples of Participant entities w.r.t. a Project entity:

OpenAIRE project		
ECParticipantNumber	*Organization*	*Person*
#1	University of Athens	Mike Hatzopoulos
#X	CONSIGLIO NAZIONALE DELLE RICERCHE	Claudio MONTANI
....	....	....

RESEAL (ERC project)		
ECParticipantNumber	*Organization*	*Person*
#1	INSTITUTO DE MEDICINA MOLECULAR	Margarida PINTO GAGO (Dr)

1.6 OpenAIRE Relational Schema

This section presents the proposed relational schema used within OpenAIRE for the representation of the project – person information, illustrated in Figure 11. The schema does not include the tables dedicated to controlled vocabularies (e.g., countries, project subjects), and again focuses on projects data only.

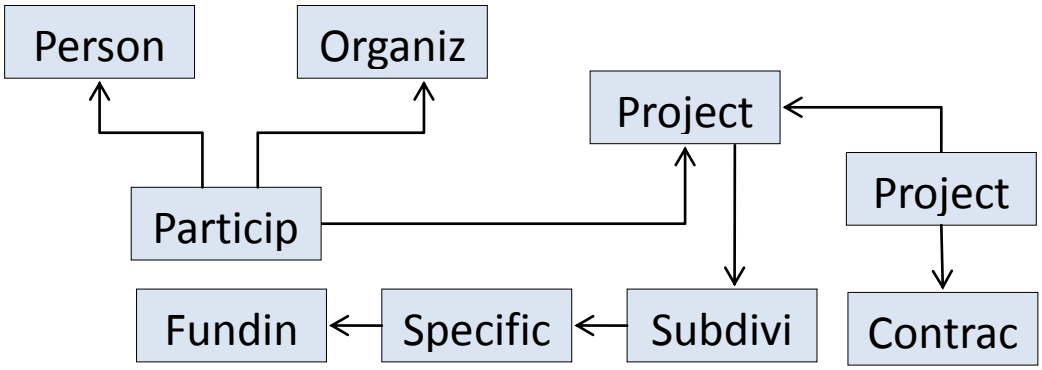


Figure 11 – OpenAIRE Relational Schema: project data

Table 2 shows the properties and the relative types of the tables at hand. Note that:

- PK: primary key
- FK Table(field): foreign key that refers to the records of "Table" identified by PK "field"
- (optional): the value of such field is not mandatory for the record to exist
- (default V): the record field is set on the value V unless otherwise specified
- "URL" String: the value is text which has the pattern of an URL address

Table 2 – Relational tables and fields

Persons	**Organizations**	**Projects**
• personID: PK • name: string • surname: string • nationality: FK Nationality(nationalityID) (optional)	• organizationID: PK • legal_short_name: String • legal_name: String • legal_status: String • web_site_URL: String • logo_URL: String (optional) • country_of_origin: FK Countries(countryID)	• projectID: PK • web_site: "URL" String • EC_project_website: "URL" String • grant_agreement_number: String • call_identifier: String (optional) • acronym: String • title: String • start_date: Date • end_date: Date • SC39: Boolean (default False) fundedBy: FK Subdivisions(subdivisionID)
Participants	**FundingProgrammes**	**SpecificProgrammes**
• EC_participant_number: PK • Coordinator: Boolean (default False) • Project: FK Projects(projectID) • Organization: FK Organizations(organizationID) • Person: FK Persons(personID) (optional)	• fundingProgrammeID: PK String • programme_name: String • programme_acronym: String	• specificProgrammeID: PK String • specificProgramme_name: string • specificProgramme_acronym: String • hasFundingProgramme: FK FundingProgrammes(fundingProgrammeID)

Subdivisions	ContractTypes	Projects_ContractTypes
• subdivisionID: PK String • subdivision_name: string • subdivision_acronym: String • hasSpecificProgramme: FK SpecificProgrammes(specificProgrammeID)	• contractTypeID: PK String • contractType_name: string	• project: PK FK Projects(projectID) • contractType: PK FK ContractTypes(contractTypeID)

1.7 Intended usage of table fields

In this section we concentrate on the three main tables Persons, Organizations and Projects and on the table Participants, which links three records, one per table, to state that

"a given organization is a participant of a given project and has entitled/assigned a given person to be the contact of the organization in the context of the project".

For each field we specify its usage in the OpenAIRE portal/service:

- *Statistics*: the field value is never displayed or published, but is rather used internally to calculate numbers from which the individual field values are not visible by the OpenAIRE end users and are not directly derivable;
- *Internal:* the field value is never displayed or published, but is to be distributed for internal use to the project, namely by the NOADs;
- *Display*: the field value is displayed, but not published;
- *Published*: the field value is published through mechanisms such as OAI-PMH or OAI-ORE to third-party applications (e.g., repository managers to achieve compliancy with the OpenAIRE guidelines).

Important note: the following sections describe the formal request to access the data submitted by the OpenAIRE consortium to the EC CORDA office and still waiting for review and validation. As such, the following tables should not be regarded as conclusive agreements, but only as the most desirable scenario for the OpenAIRE system to satisfy all its requirements.

1.7.1 Projects

Field name	Content	Notes	S	I	D	P
web_site	URL of the official web site of the project	None		x	x	x
EC_project_website	URL of the project page at CORDIS	Generated by OpenAIRE, unless available from CORDA DB		x	x	x
grant_agreement_number	Obvious	None	x	x	x	x
call_identifier	Obvious	Optional	x	x	x	x
Acronym	Obvious	None	x	x	x	x
Title	Obvious	None	x	x	x	x
start_date	Obvious	None	x	x	x	x
end_date	Obvious	None	x	x	x	x
SC39	Boolean	None	x	x	x	x
fundedBy	Identifier of Subdivision	From CORDA (not generated by OpenAIRE)	x	x	x	x

1.7.2 Persons

Field name	Content	Notes	S	I	D	P
personID	Obvious	From CORDA (not generated by OpenAIRE)	x	X	x	
name	Obvious	None		X	x	
surname	Obvious	None		X	x	
nationality	Obvious	None	x	X	x	
Contact Information				X		

S = Statistics; I = Internal; D = Display; P = Published.

1.7.3 Organizations

Field name	Content	Notes	S	I	D	P
organizationID	Obvious	From CORDA (not generated by OpenAIRE)	x	x	x	x
legal_short_name	Obvious		x	x	x	x
legal_name	Obvious		x	x	x	x
legal_status	Obvious		x	x	x	x
web_site_URL	Obvious		x	x	x	x

logo_URL	Obvious		x	x	x	x
country_of_origin	Obvious		x	x	x	x
Organization_type			x	x	x	x

S = Statistics; I = Internal; D = Display; P = Published.

1.7.4 Participants

Field name	Content	Notes	S	I	D	P
EC_participant_number	Obvious	From CORDA (not generated by OpenAIRE)	x	x	x	x
Coordinator	Boolean		x	x	x	x
Project	Identifier of Project	From CORDA (not generated by OpenAIRE)	x	x	x	x
Organization	Identifier of Organization	From CORDA (not generated by OpenAIRE)	x	x	x	x
Person	Identifier of Person	From CORDA (not generated by OpenAIRE)	x	x	x	x

S = Statistics; I = Internal; D = Display; P = Published.

1.8 Statistics

The following statistics/reports will be produced by the OpenAIRE service. Some of them were explicitly requested by the EC, others have been requested by the networking group for better application of OpenAIRE's outreach programme. *Some of the stats/reports may involve projects and publications beyond SC39, so it is advisable to have all FP7 project data available and ingested in the OpenAIRE database.*

1.8.1 For funders (EC)

Open Access evaluation: the following stats will be broken down by research area, programme, ERC, contract type (NoE, IP, etc.) country, institution,

- total number of articles published in FP7 after August 2008;
- total number of open access articles;
- average number of articles per project;
- total/average number of articles of SC39 projects;
- number of articles still in embargo period (those in 6 months embargo, those in 12 months, those with no embargo, i.e., gold);
- Project evaluation based on OA publication, broken down by research area, programme, funding (e.g., big vs. small projects), maturity of project (how long has it been going for), etc;
- number of projects that have not published any articles;
- number of projects in the pilot that have not published any articles;
- Overall compliance with the mandate (how many are, how many are not) – this in relative numbers.

1.8.2 For National Open Access Desk (NOADs), so that they can target and advance the OA efforts

- List of projects that are related to their countries. The results must provide information on projects (name, id or agreement number, URL), organizations (name, abbreviation, id or PIC, URL), and if possibly on the persons representing the projects (name, contact information). More specifically, the list of projects will be created by querying the Project's coordinator is from the NOAD's member state;
- Project's participants are from the NOAD's member state;
- All projects that relevant to their country that abide to SC39;
- All projects;
- All OA publications.

NOAD's would also like to get notifications on new projects and relative to their country.

1.8.3 Statistics unrelated to project data

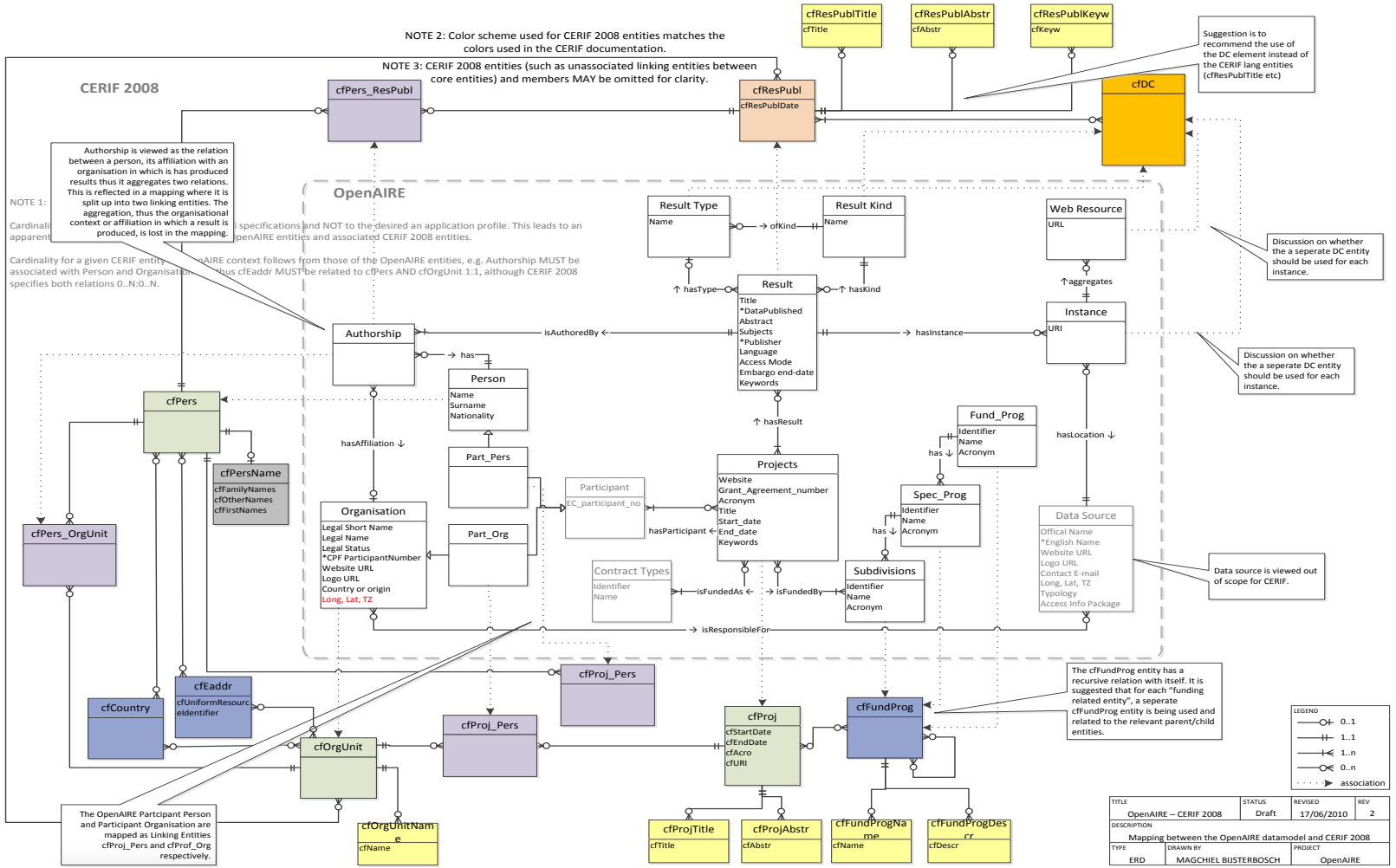
Long term statistics asked by the EC on an early meeting (Jan, 2010):

- Compare compliance rates against other mandates: not sure yet;
- Problems/issues experienced by the researchers: report from the Helpdesk;
- Citation analysis: to be delivered in the second year of operation;
- Usage data statistics: to be delivered in the second year of operation.

1.9 OpenAIRE-CORDA's interaction architecture

The purpose of this section is to define a software architecture enabling the automatic interaction between the two systems, in order to maintain OpenAIRE's content synchronized and up-to-date with the latest EC updates on projects and participants. This section cannot be completed, since the Consortium is still waiting for EC instructions on such aspects. As to now, the OpenAIRE system is updated (from "time-to-time", as no policy has been agreed) by processing Excel files generated by the EC office from the CORDA database.

Appendix A: OpenAIRE – CERIF mapping



Appendix B: OpenAIRE OAI-PMH DIDL document example

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        xmlns:dcterms="http://purl.org/dc/terms/"
        xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation=" urn:mpeg:mpeg21:2002:02-DIDL-NS
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                    urn:mpeg:mpeg21:2002:01-DII-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-21_schema_files/dii/dii.xsd
                    urn:mpeg:mpeg21:2005:01-DIP-NS
http://standards.iso.org/ittf/PubliclyAvailableStandards/MPEG-21_schema_files/dip/dip.xsd
                    http://library.lanl.gov/2004-04/STB-RL/DIEXT
http://purl.lanl.gov/STB-RL/schemas/2004-04/DIEXT.xsd">
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         </didl:Statement>
  </didl:Descriptor>
  <didl:Descriptor>
         <didl:Statement mimeType="application/xml">
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         </didl:Statement>
        </didl:Descriptor>
  <didl:Component>
   <didl:Resource mimeType="application/xml">
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                  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
                  xsi:schemaLocation="http://www.knowledge-
exchange.info/KeCrisOar/publication/1.0_KeCrisOar.xsd">
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Unported License</licence_type>
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                        <classification xml:lang="eng" source="UDC"></classification>
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      </didl:Descriptor>
         <didl:Descriptor>
            <didl:Statement mimeType="application/xml">
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            </didl:Statement>
         </didl:Descriptor>
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          xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
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exchange.info/KeCrisOar/person/1.0_KeCrisOar.xsd">
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commenced in Autumn 2008. It is co-ordinated by Dan Lindvang of  LM Glasfiber A/S,
Denmark.
                                The idea and rationale behind NanCore stems from
consideration of the scientific feasibility of developing a capable nano-based substitute for
core materials in sandwich structures, which addresses a significant market need of a
number of strategic sectors essential to the European economy and employment base.
                                The principal objective of the NanCore project is to design a
novel microcellular polymer nanocomposite (MPNC) foam, with mechanical properties and
cost characteristics allowing for a substitution of Balsa wood and PVC foam as core material
for lightweight composite sandwich structures. Besides the prospect of a significant cost
decrease, the development of a new core material will help to alleviate serious market
imperfections and supply problems suffered by European consumers of both PVC foam and
Balsa wood.
                                IOM/SAFENANO's involvement in the NanCore project
relates to determination of environmental impacts and potential health and safety risks of
nanomaterials used in the composite materials being developed. More specifically, the safety
issues workpackage considers exposure scenarios (based on information from manufacturers
of composites, industrial users of nanofillers, and a life-cycle analysis conducted within the
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