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A Translation Layer to Convey Preservation Metadata

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Abstract

The long term preservation is a responsibility to share with other organizations, even adopting different preservation methods and tools. The overcoming of the interoperability issues, by means of the achievement of a flawless exchange of digital assets to preserve, enables the feasibility of applying distributed digital preservation policies.

The Archives Ready To AIP Transmission a PREMIS Based Project (ARTAT-PBP) aims to experiment with the adoption of a common preservation metadata standard as interchange language in a network of cooperating organizations that need to exchange digital resources with the mutual objective of preserving them in the long term.

Introduction

Existing digital repositories have implemented customized management repository system and metadata infrastructures that manage their own Archival Information Packages (AIPs) (CCSDS 2002).

The cooperating organizations ability of exchanging resources in a distributed digital preservation scenario, opens interoperability issues that involve as the organizational level, as the technical level. Whereas organizational interoperability issues can be generally identified with difficulties in mutual understanding because of different languages and semantics, technical interoperability issues can be identified with differences of systems and procedures adopted.

The ARTAT project aims to face this double layered problem of interoperability, on the principle which states that technical level problems can't be solved without improving the communication among organizations on a common knowledge base.

In order to achieve better organizational interaction to solve technical interoperability issues, the experiment will test the impact of a translation into a common language supported by a common structure formally defined.

Background and Motivation

The long term preservation is a responsibility to share with other organizations. Many existing examples represent the evidence of good practices in the distributed digital preservation achieved by means of the organizational cooperation. A massive on-line literature documents methodologies, tests, and activities that are running in order to overcome the interoperability issues emerging in a cooperative context. However, project like TIPR[1], SHERPA[2], MathArch[3], etc. can rely on the adoption of a common standard container like METS. The adoption of a common standard involves the fact that the project's participants share the same knowledge base about the metadata container.

The scenario of a cooperative project where participants have not only different archiving technologies, but also different metadata frameworks, and their own business rules, has to be explored and faced on both levels, organizational and technical.

This is the case of ARTAT Italian project which deals with different knowledge base and different technology applications. The project will experiment a solution for harmonizing both framework and management of preservation metadata increasing the strategic importance of preservation metadata in a cooperative context.

The overcoming of interoperability issues, by means of the achievement of a flawless exchange of digital assets to preserve, enables the feasibility of applying distributed digital preservation policies, even in a network of multi-faceted architecture repositories.

Aim and Objectives

The project aims to provide existing digital repository with a layer of preservation metadata exchangeable with other repositories. This aim entails to create the ideal conditions for resources exchange, making the Archives Ready To the AIPs Transmission (ARTAT).

The focus is not changing existing archival systems, but strengthening their own management with a view to the long term preservation.

ARTAT is a PREMIS Based Project (PBP) and experiments the arrangement of a preservation metadata layer, encoded in PREMIS standard which will integrate repositories' preservation metadata. The export of repositories' AIPs with provision of a PML it is supposed to be received by selected repositories and ingested into its own repository system. Hopefully, thanks to the PREMIS

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[1] http://fclaweb.fcla.edu/content/news-about-%E2%80%9Ctowards-interoperable-preservation-repositories-tipr-grant

[2] http://www.jisc.ac.uk/media/documents/programmes/preservation/sherpa%20dp%20final%20report.doc

[3] http://www.library.cornell.edu/dlit/MathArc/web/index.html

translation the recipient should be able to "parse the information, map it to the structure and semantics of its own stored metadata, and even take action based on it" (Caplan 2008), in other words it should be able to "technically understand" metadata structures, and semantics.

The building of Preservation Metadata Layer (PML) will originate from archival management system and through a controlled data flow will feed the PML.

In case of exchange's need, the outcome of this workflow would consist of a DIP composed by the objects, the archiving metadata, essentially the AIP content, and PML.

In order to model PML, it is necessary to pursue objectives like to make emerging preservation metadata gaps in the AIPs management processes from participants' repositories, and to consolidate and to harmonize the preservation metadata framework of participating archival systems into a conforming PREMIS framework.

Expected Benefits

Providing repositories with a comprehensive set of preservation metadata, is supposed to be more interoperability-oriented because has been adopting by an enlarging community. The adopting organizations, will probably benefit from:

- increasing opportunities of cooperation in digital preservation;
- sharing and spreading the knowledge base about the strategic importance of preservation metadata and technical knowledge;
- deepening into PREMIS knowledge, experience and implementation;
- improving the conditions for preservation metadata management and good practices in the long term digital preservation.

Approach

The ARTAT project will work in a multi-repositories scenario, where it is likely to find differences in archival management system, in metadata application approach, and in adoption of metadata standard. In fact, it's expected that the project will deal with three different standard: MAG (Metadati Amministrativi e Gestionali) which is an Italian application profile connecting descriptive, administrative, structural and technical metadata, very similar to METS but more prescriptive; METS which is very common in the digital library community; MPEG21-DIDL which is also common in digital repositories management and comes from multimedia industry.

The methodology points to provide AIPs with PML as translation language, understandable by all projects partners, overcoming the repositories differences, and consisting of a preservation metadata set which integrates the resources' metadata.

The translation will be based on a data model deriving from the analysis of archival system architecture, the repository management processes and metadata framework. The analysis will be also documenting how repository's metadata structure flows into PML.

The translation is "a rendering from one language into another"[4] and the ARTAT choice of translating the preservation metadata into PML has been originated taking advantage from the communication among people coming from different countries. If they speak a language in common they can communicate, the more the common language is well known, and the more they can understand each other, without loss of information.

Consequently, PREMIS metadata standard will be used as interchange language because it was created by a community of experts, coming from different competence domains, and therefore it is applicable in disparate contexts. Furthermore, because it is platform independent, and it provides a common ontology of terms and definitions, used by a growing international community; it is supposed to be more "technically understandable".

These characteristics make PREMIS the ideal candidate as interchange language for archival systems, that need to transmit their own AIPs to selected repository in order to preserve them.

The characteristic of being platform independent allows a flexibility which makes organizations free of using "the specification as a key piece of its infrastructure and to adapt it to its own needs" (Guenther 2008) and consequently PML well customizable to different archival infrastructure.

When repository will be ready to test the exchange, it will export the content of AIPs into DIPs which will contain not only Information Package but also the PML built by the ARTAT software components. The addition of PML entails that the repository is able to produce XML metadata files describing the content of Information Package, even in those cases where digital resources are stored in a database management system.

The software components will effectively make the translation, complying with the defined requirements and following the directions of the resources' model. Software components will be designed and updated by the participating repositories themselves in order to fill in PML, which will be produced by a repository customized process. It is expected that all ARTAT partners will be following the methodology building, improving their own implementation practice of standard and knowledge base of preservation metadata management.

In order to build PML, the methodological approach starts examining current repository's practices in management of preservation metadata, identifying what metadata standard the partners have adopted and how it is possible to extract

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4   http://www.merriam-webster.com/dictionary/translation

preservation metadata from the repository archival systems. The examination will detect lacks or will identify locations or procedures where useful preservation metadata could be hidden.

Consequently, the general approach will consist of a "water fall model" development where the result of each phase is one or more documents that fall into the next phase (Royce 1970). The approach consists of two phases: inquiry and PML production.

The first inquiry phase will be carried out by every partner and will gather all necessary information about the objects, the repository, and the metadata.

The outcome of the first phase will allow to model the PML data structure and to design the software components necessary to PML production, which is the second phase of the project.

The workflow of the two phases is visible into the Figure 1. The outcomes of different steps will result into documents and the following steps are strongly based on the previous ones.
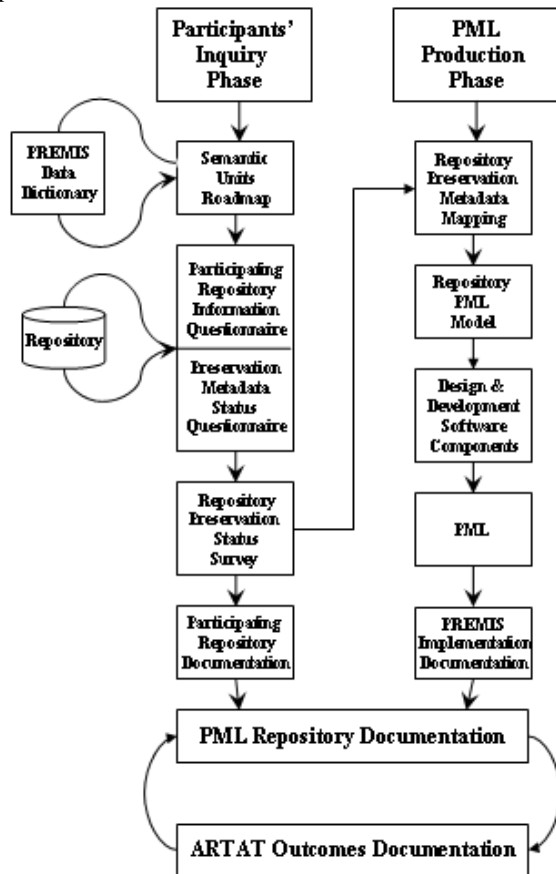

Figure 1 – ARTAT workflow

The PML Repository Documentation will feed the general ARTAT project's documentation, which gathers the documentations coming from all phases executed by every partner.

Partnership and Application Context

The ARTAT project is supported by Fondazione Rinascimento Digitale, which has constituted a partnership with Union Catalogue of Italian Libraries and Bibliographic Information, a representative institution of the Ministry of Cultural Heritage and National Library of Florence. The partnership agreement has established a Task Force (ARTAT-TF) to manage the start up, the promotion and the coordination activities of the assumed network. The network will include partners that do not necessarily have the capability to sustain the long term preservation strategies, but are willing to submit copies of their own resources into assigned partners' repositories that can provide the commitment for the long term.

The ARTAT-TF supports the start-up work packages, provides directions for the overall ARTAT workflow, promotes and organizes training events focused on the preservation metadata and PREMIS implementation. Participating organizations will be involved in the experiment by means of an agreement in which they share with other partners, objectives, conditions, requirements, and methodologies.

Furthermore, they have to engage their own selected digital resources, to make available the necessary human and technological resources, to participate in inquiry phase, to collaborate on the PML modelling, and to comply with the requirements of software design for the PML production.

The experiment application will start with three repositories:

- the ICCU[5] institutional repository which collects resources from geographically dispersed Italian cultural heritage institutions. The repository named MAGTECA, is the grounding archive of the Italian national Digital Library Portal and Cultural-Tourist Network. The portal proposes an integrated access system to the digital and traditional resources of libraries, archives, and other Italian cultural institutions, in order to promote and enhance the knowledge and availability of the cultural heritage to a national and international level. The grounding digital repository, contains more than 2.000.000 of digitalized images with the corresponding metadata consolidated in more than 29.000 documents. The metadata framework is encoded in MAG.
- Magazzini Digitali[6] is a project undertaken by Fondazione Rinascimento Digitale and National Library of Florence. The selected objects from the repository are Doctoral Thesis that are harvested by the repository

from the Italian universities institutional repositories. The metadata framework is encoded in MPEG21-DIDL.

- The digital repository of the Library & Archive of the British School at Rome[7] "a residential centre for post-graduate research in the archaeology, history, art history and culture of Italy, supporting a specialist reference Library and Photographic Archive which have produced and catalogued digital images of items from the collections of historic photographs, prints and maps. The experiment will involve all digitalized collections, that comprehend around 40.000 images with more then 13.900 metadata document. The metadata framework is encoded in METS.

Participants' Inquiry Phase

The inquiry phase is the starting point to gather information by the partners' repository in order to document and analyze types of objects, management procedures, and the preservation metadata status of the repository. The inquiry phase consists of two kinds of a semi-structured questionnaires. The first gathers information about architecture, storage and preservation process characteristics, and is based on a questions' selection from the OCLC/RLG report of the survey about current practice of digital repositories (OCLC/RLG PREMIS 2004). The second gathers information about preservation metadata status, and is based on the study commissioned by the Library of Congress PREMIS Maintenance Activity on implementation of the PREMIS semantic units (Woodyard and Robinson, 2007).

The recipient of questionnaires are participant repositories managers and/or technologists, and since ARTAT is dealing with heterogeneous archival systems, the collaboration of repository personnel has an essential role, and will be explicitly specified in the partnership agreement.

The questionnaires will be submitted to the participants as start-up work-package and will point to make clearer concepts and definitions that belong to the knowledge domain of preservation metadata management. Moreover, it is expected that will improve the faculty and quality of partners network to communicate about digital preservation, by means of the adoption of common semantics.

Other outcomes expected will be the self-documenting of the ARTAT project background and developments. The inquiry phase will be conducted with the support of the ARTAT-TF by means of interviews that will be based on the questionnaires. The interviews have been considered a better interaction with the partners and could collect also unpredicted information which would be useful to the project purpose.

Participating Repository Questionnaire

The conception of the participant repository questionnaire has taken into account the features that diversifying the repositories as materials, archival system and framework metadata standard. The aim is to explicit the information about the selected objects, the repository management processes and the differences in metadata adoption and structuring.

The questionnaire has been structured into two panels.

The first panel encompasses questions about type of selected materials and corresponding digital objects, amount of files distinguished in objects files and metadata files, and corresponding dimensioning. The information will be useful to have relevant information to get a real picture of the experiment patterns, and will be useful at the organizational level, in relation to the cooperative context, like for example to have clear information about storage needed to the AIPs exchange.

The second panel of the participant repository questionnaire will gather information about metadata and how they are recorded into the archival system, how many standards have been adopted, how metadata are connected to the objects, and how or if metadata is incapsulated into the container.

An important but difficult part is the way the metadata has been implemented, which means to provide evidence of the external relationships among metadata files and the internal structure of metadata files. Consequently, the repository have to provide a representative data model of external and internal relationship of the metadata structure.

Well known examples are MIX[8] files that can be incapsulated into the METS or externally referred, or objects that can be individually associated to one complete MIX file or associated to one individual MIX file, and to one MIX file containing technical information shared also by other objects.

A reference model of repository's metadata structure is necessary to build the metadata relationships of the PML core.

Preservation Metadata Status Questionnaire

The second questionnaire aims to get a picture of repositories preservation metadata management. Consulting PREMIS Data Dictionary[9] and analyzing semantic units, the questionnaire was conceived with the assumption that some preservation metadata is certainly managed by the repository, some can be simply extracted from the objects, and some can be collected from the preservation processes. Consequently, the questionnaire content has been derived from a Semantic Units Roadmap (Fig. 1) which is the reference document for understanding

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7   http://digitalcollections.bsrome.it/

8   http://www.loc.gov/standards/mix/

9   http://www.loc.gov/standards/premis/v2/premis-2-0.pdf

clearly how the values of semantic units will be gathered by the project, and how it classified them in relation to the application context. The roadmap classifies the semantic units in: questioning unit, automatically assigned by the ARTAT add-ons, automatically ascertain by the ARTAT add-ons, assigned as default, requirement base assigned.

The project has restricted the object categories applicability only on files, in order to ease the approach of participants with PREMIS semantics.

Another expected questionnaire's outcome is to collect entries for controlled vocabularies from partners or test the applicability of predefined controlled vocabulary. For example, the eventType controlled vocabulary entries were selected from the "comparison table of controlled vocabulary in use for eventType" in PREMIS semantic units survey (Woodyard and Robinson, 2007).

Resulting controlled vocabularies will be shared and used by network partners.

Reporting of Inquiry Phase

The conclusion of inquiry phase of individual partner will be reported in a basic document containing the results. The report will be used for the specification of the requirements and the PML model, customized for the repository's context. The architectural model will be submitted to the partners to negotiate the software design and development for producing PML.

Software components will be build by the partners with support of ARTAT-TF that will ensure the compliance to the PML requirements.

PML Production Phase

The outcomes of inquiry phase will consist of a metadata mapping document where will be traced the correspondence of repository's metadata and the PREMIS semantic units. The dataflow mapping will be the foundation for PML modelling which will drive the design and development process for the software component building. The software components will enable the repository to extract from the repository all metadata necessary to the exchange, in other word will produce the PML. The PML production workflow will be opportunely documented by the repository with support of ARTAT-TF.

PML Details

The Preservation Metadata Layer will be composed by the repository's AIP and an addition of a preservation metadata set which will result from the previous workflow phases.

The translation process is more than a simple communication process. It is not only encoding and decoding but first of all it is an interpretive process, composed by sign, object and interpretant as American philosopher Charles Peirce asserts (Petrilli S. 1999). As translation layer the PML will copy the repository's

preservation metadata, already encoded in some standard (objects and signs) and will translate them in PREMIS (interpretant) with the integration of those metadata which were not provided in an explicit form. However, the translation effort, as said, has to be sustained not only at technological level, but also at organizational level.

The first requirement for building PML is the PREMIS conformance. The second requirement is to achieve as much as possible the PREMIS metadata comprehensiveness, since the repository could have some missing or implicit preservation metadata. The third requirement is the independence of PML from the AIPs, making its reuse easier and its preservation feasible also in different technological contexts.

The **PREMIS conformance requirement** demands to:
- follow the specification of PREMIS Data Dictionary (DD) names and definitions of semantic units,
- adhere DD applicability guidelines,
- conform to repeatability and obligation,
- encompass mandatory semantic units as a minimum amount of metadata useful to preserve digital objects in the long-term.

This minimum amount of information will be the minimum necessary for the PML, and PREMIS conformance is an obligation to respect in the PML production processes. Since it is a necessary condition under that the AIPs receiving repository can "accept custody of the digital object and assume responsibility for its long-term preservation" (PREMIS 2008).

The **comprehensiveness requirement** of PML encompasses preservation metadata and the more will be exhaustive and the more will be technically interpreted by other repository systems. Furthermore the knowledge of partners, both sending and receiving, achieved for capturing as much as possible information to include into PML, could lead them to find solutions for improving their repository management and for enabling long term strategies.

The limited use of extensions containers will be a sub-requirement of comprehensiveness. The comprehensiveness meaning has to be related uniquely to the PREMIS semantic units and not to the unconditional use of extensions, that have to be used only when it is strictly necessary.

The **PML independence from AIPs** is important to allow third party to rebuild connections among objects, and to technically understand and interpret the AIPs redundancies produced by the duplication of some kind of metadata into the PML. Because it is supposed that all participating repositories will be well-acquainted about the PML structure, its independence will facilitate the AIPs interpretation process.

PML Structure

The PML will consider as its target the repository's AIPs, and in particular the XML metadata, describing content, which is supposed to be produced from a database or held into filesystem. The layer will be added by means of populating PREMIS semantic units from repository preservation metadata and from other source of information located by the inquiry phase.

The layer will be composed by an XML layer which describes characteristics of the Information Package's metadata and duplicates and integrates the preservation metadata of the objects.

In other words the layer will describe technically and structurally the AIPs content.
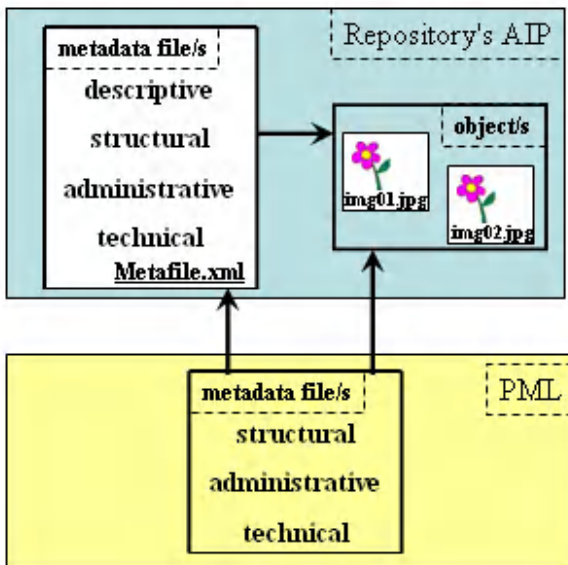

Figure 2 – Preservation Metadata Layer

The PML part describing the XML metadata files referring to the objects is considered the core of PML and it can be also defined as meta-metadata part. Because XML metadata files are objects themselves the description will follow the same procedure of another type of objects.

What will differentiate these "special" objects from the others will be the characteristics considered like significant properties. Therefore, the *significantProperties* container will be required as mandatory in the PML production, and values will be provided under selection from a controlled vocabulary.

The PREMIS identifier systems will support the connections between PML core and the Information Package's metadata, and PML non-core part and the objects.

The Figure 3 shows an abstract of a representative example of a PML. The principal mandatory containers like *objectIdentifier*, *objectCategory* etc. are included only as reference.

The sample values are included in square brackets. The *significantProperties* container is repeated for every

metadata standard contained in the hypothetical AIP and includes merely values for *significantPropertiesType* and *significantPropertiesValue* separated by semicolon.
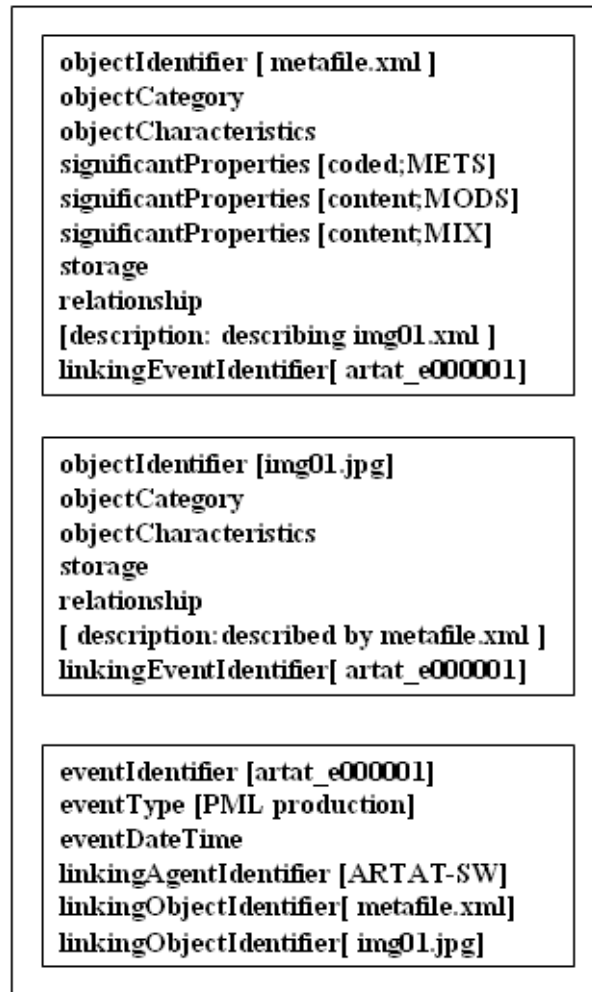

Figure 3 – PML sample

By means of this significant properties description, it is evident that the Information Package's metadata file has been encoded in METS, and contains MODS and MIX metadata. The *relationship* container will describe structurally the AIPs and internal relationships between metadata and objects. The more the vocabulary entries will be detailing relationships and the more the PML core will be meaningful for receiving partners.

Appropriate controlled vocabularies for *significantProperties* and *relationship* have to be refined during the inquiry phase, and feasible models of metadata structures have to be investigated.

The PML objects will be referred to the event PML production by means of *linkingEventIdentifier* and the event conversely will link all objects with *linkingObjectIdentifier*.

"Translation In" and "Translation out"

Because metadata describing packages, should constitute an XML object, what has been underpinned as significant properties is the structure connecting different functional metadata. To note down that the container standard like MAG, METS or MPEG21-DIDL encompass descriptives like MODS or DC and technical MIX metadata, becomes extremely useful information for receiving partners. They will be able to locate not only different metadata section but also metadata redundancies.

Indeed, the administrative metadata can be conveniently reproduced into the PREMIS entities semantic units, For example, the METS administrative sub-sections can be mapped into the PREMIS semantic units. METS:techMD, METS:digiprovMD and METS:sourceMD can conveniently mapped into the PREMIS:Objects semantic units and connected by means of PREMIS identifiers system as well as METS:rightsMD sub-section can be mapped into the PREMIS:rights semantic units.

A partner repository which receives the AIPs supplied with PML, even without knowledge about METS can have a preservation metadata package ready to be submitted to its own management processes, on condition that it is able to intepret the PML and has adopted strategies to manage preservation metadata.

The receiving repository will preserve the METS file like other objects.

Whereas a preservation event occurs you can depict two distinguished types of events: a low impact event where only PML has been involved, because the repository has left the alien AIPs 'as is', and the event's trace will be annotated, as preservation metadata, only into PML; a high impact event where not only the PML, but also the objects and/or metadata objects have been involved. In the last case, redundant metadata probably will be involved and updated by means of checking differences obtained by the comparison of original AIPs metadata and PML duplication metadata. The fact of changing the original AIPs objects forces to find solutions about the creation of new one AIP and how it should be structured.

The success of PML solution, strongly depends on the correct interpretation of the PML, which entails that the systems, and obviously before the organizations, have knowledge base of PREMIS standard and PML structuring, as "interpretant" of translation process.

Conclusions and Future Developments

Taking up the challenges of digital preservation and stewardship, means to find "ecological" solutions and precautions for current archival information systems. The adoption of a common interchange language will enable to submit and to disseminate packages in understandable way to all of them adopting the same language. This solutions will succeed if current systems will be able to exchange resources flawlessly. Nevertheless, it contributes to spread awareness about the preservation metadata strategic importance, tests an *a posteriori* implementation of preservation metadata and assesses the impact of such solution on existing systems and on established organizational procedures. The project will start in November 2009 and the methodological approach will be improved during the remaining months of 2009. The project will involve other network partners during 2010. First outcomes' report is expected by June 2010. Partners interested in experiment of PML implementation comes from different domains like museums, archives, academic institutions and public administrations. The ideal scenario to test strongly the PML solution is disparate application domains. Results of experiment as emergent critical situations, as lesson learnt and successful practices will be published in order to share the experience of implementing preservation metadata set in existing archival systems.

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