OAIS in the digital preservation of sound archives

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ABSTRACT

How can an organization provide for long-term conservation, information access and management of large volumes of digital audio contents? Currently, this question is a key concern for the audio sound archivist, who faces the challenge of managing vast volumes of digital objects produced in the systematic creation of digitized audio collections. In this situation, document processes, the roles of personnel and the techniques and technologies used in analogue archive management have fallen into disuse. Furthermore, a digitized audio archive collection preservation model has yet to be formulated that can serve in the long term to aid in understanding the terms, concepts and

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processes entailed in an audio archive after it has been digitized. In view of this, this paper adopts the Open Archival Information System (OAIS) as a reference model in the long-term design, development and management of reliable digitized audio archives.

Key words: Digital sound preservation, open archival information system, sound archive, sound document.

RESUMEN

El OASIS en la preservación digital de archivos sonoros

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¿Cómo conservar, dar acceso y manejar grandes cantidades de contenidos digitales sonoros a largo plazo? Esta pregunta expresa una de las preocupaciones actuales de los responsables de archivos sonoros que enfrentan el desafío de administrar vastos volúmenes de objetos digitales que provienen tanto de la digitalización como de la generación sistemática de colecciones sonoras digitales. Ante tal situación los procesos documentales, los roles, las técnicas y las tecnologías utilizados en el archivo analógico han quedado en desuso. Además, se carece de un modelo de archivo digital que garantice la preservación de colecciones sonoras a largo plazo y que ayude a comprender los términos, conceptos y procesos del documento sonoro una vez que ha sido digitalizado. Ante tal escenario, en este artículo se analiza el OAIS (Open Archival Information System) como el marco de referencia para concebir, desarrollar y administrar un archivo digital sonoro confiable, de largo plazo y sustentable.

Palabras clave: Preservación digital sonora; Sistema de información de archivo abierto; Archivo sonoro; Documento sonoro.

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Introduction

The increase in the number of digital sound collections is the result of the transfer of recorded analogue contents to digital supports and increasing growth in the production of digital documents. In Europe alone the annual digitization rate is 280,000 hours.[1]

In conjunction with this increase in digitized sound collections, there has been a rapid expansion of production, distribution and access to digital sound documents,[2] resulting from the recording and re-editing of music, the emergence of audio-on-demand services and online radio broadcasts and sound art platforms and sound landscape, among others. Brylawski and Bamberger[3] have noted that the Web provides access to the greatest number of recordings in digital format as has ever been available in history. Most of the sound documents of digital origin are not systematically collected and many are lost irretrievably.

Documents of a digital origin already make up part of documental collections. Recent research indicates that 89% of European institutions dedicated to the preservation of sound and audiovisual documents preserve only original digital documents, which is to say they do not keep equivalent facsimiles in analogue format or that such analogue documents have not yet been digitized. [4]

In view of the growth of digital sound collections, the traditional preservation model has become obsolete. Consequently, the concept of digital preservation of sound contents has been implemented more widely. Van Malssen[5] cautioned that digital preservation would require new approaches, workflows, tools, resources and skills. Moreover, one must take into account a series of risk factors, including failures in storage media, hardware and software problems, and network service glitches. Other risks include those associated with communication systems used to transfer files, hardware and software obsolescence, human error, natural disasters, external or internal

1 Richard Wright, ICT-2007-3-231161. Status Report 4.
2 Kara van Malssen, "Planning Beyond digitization: digital preservation of audiovisual collec tions", 71.
3 Sam Brylawski y Rob Bamberger, The State of Recorded Sound Preservation in the United States: A national Legacy at Risk in the Digital Age, 48.
4 Natasha Stroeker y René Vogels, "Survey Report on Digitisation in European Cultural Heritage Institutions 2012", 2.
5 Kara van Malssen, "Planing Beyond digitization…", 72.

attacks, and lack of continuity in the provision of economic and organizational resources.[6] Another important risk, which should not be omitted, is loss of metadata associated with thousands of documents.[7] Another factor that jeopardizes digital files is insufficient staffing or turnover of personnel working in the archive, whether because of lack of budget or when a new political administration comes into power. Such turnover, means new staff must learn to the processes to perform digital preservation.

Because of these risks associated with digital preservation, digital archives or repositories must ensure that digital bits remain intact over time, while offering both access and proper management of contents.[8] Several authors have also been pointed out that the digital file must be reliable. This is the central focus of many developments and discussions regarding the care of digitally supported contents.[9]

In the absence of a digital repository model that addresses the risk factors of digital preservation and which also provides a reliable and sustainable service, thinkers over the last decade have attempted to set standards for long-term preservation of digital materials. For this reason, we have begun to use international models and standards such as the Open Archival Information System (OAIS), designed as a model for the creation of an open file information system. Additionally, the Preservation Metadata Implementation Strategies (PREMIS) and METS (Metadata Encoding and Transmission Standard) have been developed to produce, manage and conserve metadata. With regard to auditing and certification criteria of a digital archive, the Trusted Repositories Audit and Certification: Criteria and Checklist (TRAC), issued by the National Archives and Records Administration (NARA) and the Center for Research Libraries (CRL), have been established. Other standards include the Catalog of Criteria for Trusted Digital Repositories, created by Nestor (Network of Expertise in Long-Term Storage of Digital Resources) and DRAMBORA, a set of risk assessment tools created by Digital Preservation Europe and the Digital Curation Center of the United Kingdom.

This article analyzes the OAIS (Open Archival Information Systems), posited as the frame of reference for conceiving, developing and managing a digital sound file. It starts with the presentation of the documental processes

6 David Rosenthal et al., "Requierements for digital preservation Systems"; Kara van Malssen, "Planing Beyond digitization…", 75.
7 *Idem*.
8 *Idem.*
9 S. M. McMeekin, "With a Little Help from OAIS: Starting down the Digital Curation Path".

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of a sound file and the changes brought about by digitization of the sound documents. We continue to examine how the sound document, whose contents have been digitized or entered into digital platforms, takes the form of a digital object formed by two essential components, i.e., digital audio (also called essence or media) and metadata. Thereafter, Digital Mass Storage and Management Systems (SGAMD), the first repositories for the conservation of digital sound collections, were established as the antecedent for the management of digital contents of sound files. The presentation of this concept leads to the exegesis and analysis of OAIS as a frame of reference for the creation of a reliable and sustainable sound digital archive information system.[10]

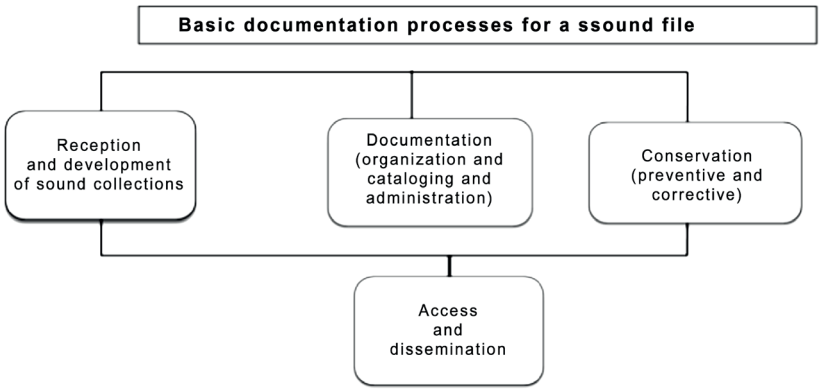

Figura 1. Source: by author

Digitalization of analogue material introduced a new process that modified the preservation tasks[11] (see Figure 2). Digitization has been defined as the process by which the analogue signal is replaced by a digital signal. That is, the contents recorded on various obsolete analogue media are transferred to digital platforms, because the equipment and associated technical maintenance needed to reproduce analogue signals no longer exists. [12]

Mechanical or magnetic analogue media can be digitized. The mechanical supports allow for mechanical recording and reproduction, exploiting

10 LASA, TC 03 *La salvaguarda del parimonio sonoro. Ética, principios y estrategias de preservación.*
11 *Idem*.
12 *Idem*.

groove that is carved into the surface with a needle or sharp instrument. [13] This technique is seen in cylinders of wax, celluloid and amberol; and disks of shellac gum, shellac, vinyl and polystyrene. Magnetic media, extensively studied by Van Bogart, [14] rely on the use of ferromagnetic material to record and reproduce the sound. Wire reels, open spool tapes, cassettes and cartridges are of this type. On the other hand, laser light is used in optical media to write and read encoded data on the recording surface. [15] This type of supports, also called digital supports, are based on the use of binary code used to affix the sound. Recording and reproduction of sound files in this support requires the use of digital technology. These digital technologies include DAT (Digital Audio Tape), CD (Compact Disc), DVD (Digital Versatile Disc) minidisc and Blu-ray. This type of media is not digitized, but rather its content is introduced to digital platforms for preservation and subsequent access.

The digitization and placement of digital content on digital platforms modified traditional documentary processes and entailed new tasks and workflows in the archive, including the creation of a permanent ID or code that links the digital audio (media or essence) to metadata; validation and systematic verification of both cataloging and digitization; immediate access to contents and inventory data once the item is digitized; remote access; permanent verification of integrity and consistency of both digital audio and metadata; daily and periodic backup of the media or digitized audio contents and the metadata and maintenance; and control of temperature and humidity of the digital vault, among others. [16]

In the early days of digitization of analogue contents, the useful life of the digital document and associated preservation requirements were not well understood. Transferring the analogue content to a digital medium was understood as the only way of preserving such contents. Over time, archive specialists realized that a digital preservation model was needed[17] in order to ensure long-term preservation of digital and digitized contents. [18]

13 Miguel Díaz-Emparanza Almoguera, La digitalización de los soportes sonoros en archivos de radio, 136.
14 John van Bogart, Almacenamiento y manipulación de cintas magnéticas. Guía para bibliotecas y archivos.
15 Miguel Díaz-Emparanza, La digitalización…, 158.
16 Perla Olivia Rodríguez Reséndiz, El archivo sonoro. Fundamentos para la creación de una fonoteca nacional.
17 Richard Wright, "Digital preservation of audio, video and film".
18 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant Preservation Workflows in an AV Archive".

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Moreover, digital preservation had been seen as a complex field, because of rapid changes in technology and there is no single or clearly recommended solution to such preservation tasks.[19] This situation brought to light the need to about sustainable digital preservation,[20] that provides for the economic, social and technical infrastructure in the long term in order to preserve the data without loss or significant degradation. This entails a comprehensive approach to preserve sustainable goods,[21] while ensuring easy access allowing extensive exploitation and distribution.[22]

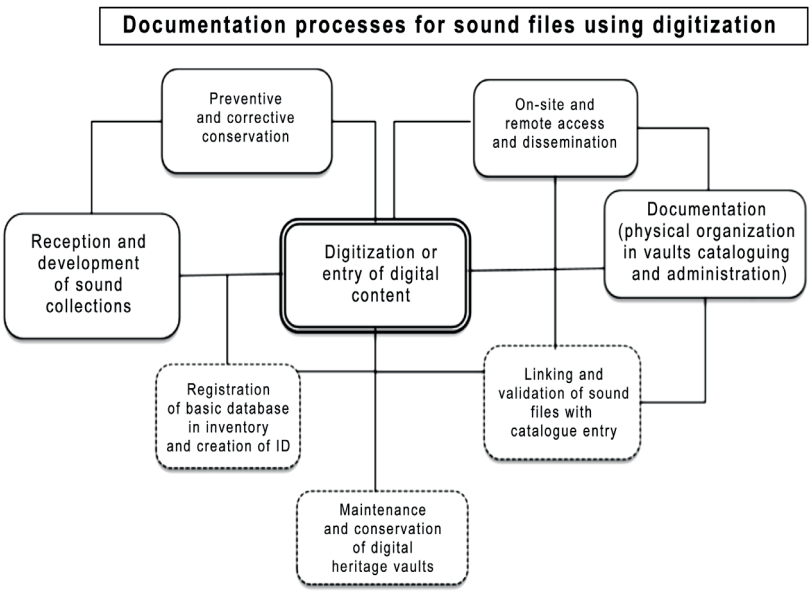

Figura 2. Source: by author

The sound document as digital object

The Charter for Preservation of Digital the Heritage[23] states that long-term digital preservation begins with the design of reliable systems and

19 Milena Dobreva y Nikola Ikonomov, "The Role of Metadata in the Longevity of Cultural Heritage Resources".
20 Kevin Bradley, "APSR Sustainability Issues".
21 Richard Wright, "Digital…", 76.
22 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".
23 Unesco, "Guidelines for the preservation of digital heritage".

procedures capable of creating authentically stable digital objects. Through digitization and digital entry the sound document, it becomes a digital object consisting of digital audio, also called media or essence, and metadata.

As for audio, the recommended standards set sampling at least 48 kHz. For certain types of content, such as ethnological recordings from research files, frequencies higher than 96 kHz can be used.[24] Additionally, a quantification of at least 24 bits has been established for digitization and digital documents, and the bit depth of the storage technology must be equal to that of the original item. This quantification offers a dynamic range that approximates the physical limits; 16-bit audio (the CD standard) may be unsuitable for many types of materials, especially where very high frequency transitions must be quantified: such is the case for damaged discs. [25] To ensure proper digital preservation, the digitization parameter should be at least 48 kHz per 24 bits. [26]

The IASA TC-04 has established that

> once the audio has been encoded as a data file, its preservation faces the normal manipulation to which digital data is subject, and it must be assigned persistent identifier (ID) and appropriate metadata for administration purposes.[27]

Metadata is a fundamental pillar for long-term management and administration of digitized sound collections. Metadata serve to identify and structure information, and to make it retrievable.[28]

For the purpose of digital preservation, the National Library of Australia[29] suggests metadata should provide:

- Technical information for system administrators to support f decision-making and conservation actions.
- Information on previously adopted conservation actions, such as policies governing migration or emulation.
- Record the effects and consequences of conservation strategies.

24 IASA, *La salvaguarda…*, 9.
25 *Idem*.
26 *Idem*.
27 IASA, *Lineamientos para la producción y preservación de objetos de audio digitales. TC-04*, 3.
28 Annemieke de Jong, *Los metadatos en el entorno de la producción audiovisual*.
29 National Library of Australia, *Preservation Metadata for Digital Collections: Exposure*.

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- Guarantee the authenticity of digital resources.
- Information on the management of copyright and information access.

According to the Working Group on Preservation Metadata, the types of information listed above have two purposes: 1) to provide digital file managers with sufficient knowledge to maintain the digital object's bit string in the long term, and 2) to ensure that the content of a archived object can be represented and interpreted, despite changes in access technologies occurring in the future.[30]

The development and implementation of the metadata has become a field of specialization leading to the creation of PREMIS[31] metadata digital preservation standard.[32] Caplan makes the following observation about the PREMIS:

> Metadata is classified into categories according to the functions they perform. Descriptive metadata serves for identification and retrieval. Administrative metadata aids in management and tracking. Structural metadata indicates how to assemble complex digital objects so they can be viewed or used in some way. Similarly, preservation metadata supports activities whose aim is to ensure the long-term use of a digital resource.[33]

In addition to PREMIS, the Metadata Encoding and Transmission Standard (METS), the standard for metadata exchange and storage, has been created and is a system that operates without regard to the specific needs of the file. METS is a representation standard for expressing the hierarchical structure of digital objects in a library, including the names and location of files comprising digital objects and metadata. METS allows the external use of metadata schemes that can be defined in distinct sections.[34] The common format of information packet transfer between digital repositories is based on the use of METS and PREMIS.[35]

30 OCLC/RLG, *Preservation Metadata for Digital Objects: A Review of the State of the Art*, 4.

31 PREMIS (Preservation Metadata: Implementation Strategies) es el nombre del grupo internacional de trabajo que elaboró el Diccionario de metadatos de preservación que define un conjunto de unidades semánticas que deben entender los repositorios digitales para llevar a cabo la preservación digital.

32 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…", 4.

33 A. P. Caplan, *Entender PREMIS*, 3.

34 M. Addis *et al*., "100 Million Hours of Audiovisual Content: Digital Preservation and Access in the Presto PRIME Project Categories and Subject Descriptors", 6.

35 Angela Dappert y Markus Enders, "Digital preservation metadata standards".

It has been observed that it is necessary to understand the nature of the sound document within a digital preservation environment. In this regard, it should be noted that unlike the analogue sound document, the digital object is polymorphic, which according to Thibodeau exhibits the following features:

- Digital data cannot be permanently attached to a physical support.
- Storage media must be replaced periodically.
- The boundaries of the digital object are difficult to determine.
- Digital objects must be processed for use.
- There is a relationship between what is conserved and what is offered for consultation. [36]

The archivist or sound documentarian, who for many years have had to handle analogue supports artefacts of diverse sizes, materials and forms, is now faced with the challenge of understanding that these sound documents have been replaced by digital objects, which cannot be handled for the purpose of carrying out documental processes, but nonetheless must be subjected to specific preservation processes specific to the digital archive.

Digital mass storage systems

For a long time as analogue holdings grew, sound and audiovisual archives had to negotiate to secure space in storage vaults. The transfer of analogue content to digital platforms through digitization shifted storage from analogue storage vaults to digital legacy vaults housing Digital Mass Storage and Management Systems (SGAMD) were installed. The SGAMD is a fully automated system designed to store, manage, maintain, distribute and preserve a complex set of inherited digital objects and associated metadata.[37] Thus, the analogue file was modified through the creation of a digital file capable of handling a certain number of digital objects logically and adapting to adapt to the constant rules of change.[38] To achieve this flexibility, the solution had to be integrated by several modules. [39]

36 Kenneth Thibodeau, "Wrestling with Shape Shifters Perspectives on Preserving Memory in the Digital Age".
37 IASA, Lineamientos…, 54.
38 Stephano Cavaglieri, "Criteria to consider in the definition of Digital Mass Storage Systems", 152.
39 Björn Blomberg, "Sistema de Almacenamiento Masivo Digital", 99.

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The emergence of Digital Mass Storage and Management Systems[40] coincides with the advent in the 1990s[41] of digital asset management using technologies such as Digital Asset Management (DAM). [42] The first SGAMD in sound archives were installed at the beginning of 1990s and are the antecedent of the first digital sound collection repositories. Schuller has pointed out that the idea of the digital archive was fleshed out within the framework of the 90th anniversary of the *Phonogrammarchiv* in Vienna (at a meeting organized by UNESCO) that gathered manufacturers of technical equipment for sound and audiovisual archives. That meeting highlighted the need, after digitization of the object, for generating an automated copy to support long-term content management. [43]

Over the last three decades, the fundamental design of the digital archive has remained largely unchanged with regard to the functions of storage of media, or essence, and metadata. The contemporary digital archive, however, needs more than a magnetic tape storage room and a spreadsheet for the catalogue,[44] especially in light of the large volumes of digital content requiring preservation. Therefore, it is necessary to conceive of and develop reliable and sustainable digital files that take into account the risk factors associated with digital preservation. In the absence of a model of a digital file in sound collections, the IASA[45] second edition of the *TC-04 Guidelines for the production and preservation of digital audio objects* incorporated Open Archival Information Systems (OAIS) as the standard for designing, developing and managing a digital sound file.

OAIS

In 2003, OAIS was accepted as an international standard for the design of information systems in an open file. [46] The OAIS identifies and describes the

40 IASA, Lineamientos…
41 Àngels Jiménez, "Digital asset management : la gestión de información multimedia en las organizaciones", 453.
42 Kevin Bradley, Hacia un Sistema de Almacenamiento y Preservación en Código Abierto. Recomendaciones respecto a la implementación de un Sistema de preservación de archivos digitales y temas en torno al desarrollo de software.
43 Kate Murray, "Audio for Eternity: Schüller and Häfner Look Back at 25 Years of Change".
44 Hilary Beedham et al., "Assessment of UKDA and TNA compliance with OAIS and METS standards", 6.
45 IASA, Guidelines on the Production and Preservation of Digital Audio Objects.
46 ISO 14721, The Open Archival Information System Reference; Hilary Beedham et al., Assessment of UKDA…, 6.

processes that must be incorporated into data centers, repositories and archives to preserve data in the long term and to make them available to future users. [47]

Although the OAIS was designed to manage physical objects, it has carved out a greater presence in the digital realm, where it is seen as a model for an open file information system[48] [49] [50] comprising all the functions of a digital repository, [51] while providing the common language and archival conceptual framework for digital storage and preservation specialists.[52] In this way, OAIS contributes to the understanding of archival concepts of conservation and access to digital information. OAIS documents the processes and life cycle of the digital object, since it is incorporated into the digital file.[53] The digital object content (CDO) and its metadata in OAIS are stored in file information packets (AIP).[54]

Theodoridou disagrees with the idea of OAIS as a model. In his view, OAIS does not set forth any particular conceptual model or ontology. It merely posits that each digital information object must be associated with the representation of the information necessary for the interpretation of the digital object, including information about the structure and semantics of the digital object. It suggests that the description of information for preservation (DIP) should contain data on the origin and history of the object, but this is not a specific model.[55]

In addition to these consideration, it has been pointed out that OAIS does not offer a perfect fit for every file[56] and that it focuses on the ability to access and interpret records through the creation of information; but does not provide information about the representation of the preservation

47 B. F. Lavoie, Technology Watch Report The Open Archival Information System Reference Model : Introductory Guide.
48 P. Laughton, "OAIS functional model conformance test: a proposed measurement".
49 M. Dunckley *et al*., "Using XFDU for CASPAR information packaging".
50 B. F. Lavoie, *Technology Watch…*
51 P. Laughton, "OAIS functional model…"; Teresa Silió, "Fundamentos tecnológicos del acceso abierto: Open Archives Initiative y Open Archival Information System".
52 Kevin Bradley, *Hacia un Sistema…*; Milena Dobreva y Nikola Ikonomov, "The Role of Metadata…".
53 M. Theodoridou et al., "Modeling and querying provenance by extending CIDOC CRM", 171.
54 M. Dunckley *et al*., "Using XFDU…", 81
55 M. Theodoridou *et al*., "Modeling and querying…", 171.
56 Milena Dobreva y Nikola Ikonomov, "The Role o f Metadata…"; Dennis Nicholson y Milena Dobreva, *Beyond OAIS: Towards a reliable and consistent digital preservation implementation framework*.

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environment.[57] Criticism has focused on reliability, not only because information (records) should be preserved, but because description of the environment (the "context") used to manage and read records is needed. [58]

Without omitting the theoretical and methodological criticisms of OAIS and the need to have a frame of reference for the creation of a digital archive by which large volumes of digital information are managed, many archives have begun to use this information standard.[59] The OAIS has been seen as the standard for long-term data sustainability[60] and care, as well as a way of enhancing reliability of a digital repository.[61]

In the field of sound archives, these attributes are fundamental in ensuring the digital preservation in the long term. In this regard, Van Malssen has pointed out:

> OAIS is a high-level model of the functions, processes, responsibilities and information required to implement a digital preservation repository. It also defines the mandated duties a digital repository is expected to deliver, including negotiation and acceptance of appropriate information from creators, controlling information to meet long-term preservation, and documenting policies and practices to ensure preservation of information against reasonable contingencies.[62]

Moreover, for an archivist or sound documentalist, it provides the framework, terms and concepts for long-term storing digital objects in a digital file

OAIS has been used to design diverse digital preservation models, such as the Tsinghua Digital Preservation Platform (THDP) and the Joint Information Systems Committee (JISC) of the United Kingdom,[63] among others. In the field of sound and audiovisual archives, the adoption of the OAIS in Presto Prime, a European project for the research and design of technology for the digital preservation of sound and audiovisual collections, [64] stands

57 Reagan Moore, "Towards a Theory of Digital Preservation"; P. Watry, "Digital preservation theory and application: Transcontinental persistent archives tested activity".
58 R. Moore *et al*., "Implementing Trusted Digital Repositories", 5.
59 Kevin Bradley, *Hacia un Sistema…;* Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".
60 P. Laughton, "OAIS functional model…".
61 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".
62 Kara van Malssen, "Planing Beyond digitization…", 77. (Traducción propia.)
63 P. Laughton, "OAIS functional model…".
64 M. Addis *et al*., "100 Million Hours…".

out. This move is also evident in the Instituut voor Beeld in Geluid in the Netherlands.[65]

Structure and components of OAIS

OAIS can guarantee the integrity and authenticity of digital objects and thus lay the foundations for the creation of a reliable digital repository.[66] In order to document the integrity of a file requires that the data not suffer corruption during the digital migration. Moreover, in order to demonstration of the authenticity of a file/object over time, we need to know where the document comes from, when it was created, and origin and changes it has undergone throughout history. This process occurs across the phases through which a digital object passes in OAIS. [67]

Van Malssen[68] identifies three areas that OAIS describes: 1) the external environment, 2) the information packages that are preserved and disseminated, and 3) the functional components of the digital archive.

The external environment

In OAIS, the external environment is determined by the production community, the designated community and content managers. The producer community can be anyone outside the digital repository responsible for creating content, such as a radio producer, artist, journalist, researcher, musician or even a curator who selects sound content to be included in the archive. This area has an impact on internal functions, policies, practices and conservation methods and access to content. Content managers are responsible for securing funding, managing and designing strategic plans for digital archive. The designated community is made up of all users of a digital archive, comprised of administrators, curators, educators, creators and the general public interested in consulting digital content.[69]

65 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".
66 *Idem*.
67 *Idem*.
68 Kara van Malssen, "Planing Beyond digitization…".
69 *Idem*.

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Information packets

OAIS is built on the basis of information packets, concepts defining the information structure that moves inside, through and outside the archive system. The information package is the digital object, the core of preservation task, including the metadata needed to maintain long-term preservation and provide access.[70] During the digital life cycle, the information packages made up of relevant data and metadata needed for management of digital objects, include following:

1. Submission Information Package (SIP), the incorporation of media, essence or contents and metadata into the system.[71]
2. The SIP is accepted in the system and used to create an Archival Information Package (AIP).[72]
3. Archival Information Package (AIP) is the information package stored and preserved within the system.[73]
4. Dissemination Information Package (DIP) is the information package created to distribute digital content[74] and which can be consulted by users.[75]

Functional components

The functional architectural components of OAIS include intake, access, administration, planning, data management and file storage.[76] These areas are associated through processing flows where metadata are added, thereby creating digital information packets in such a way that an object's life cycle is documented with metadata.[77]

OAIS intake is the process by which content and metadata (SIP) are accepted and verified, and the file information package (SIP) is prepared for storage. Data added during the intake process serve to establish the rights of use of the document incorporated in the digital archive.[78] In the analogue file, this stage corresponds to the collection of sound documents whose incorporation into the archive is done by signing a legal establishing the copyright of

70 B. F. Lavoie, *Technology Watch…*
71 *Idem;* Kevin Bradley, *Hacia un Sistema…*
72 Kevin Bradley, *Hacia un Sistema…*
73 *Idem;* B. F. Lavoie, *Technology Watch…*
74 Kevin Bradley, *Hacia un Sistema…;* IASA, *Lineamientos…*
75 B. F. Lavoie, *Technology Watch…*
76 M. Addis *et al*., "100 Million Hours…".
77 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".
78 IASA, Guidelines…

the incorporated documents or collection. For many years this activity was done manually and the agreements were stored in order to account for the legal scope and limitations of the collections. In the digital repository, the rights of use of the digital object must be clearly established from the moment a digital document is incorporated in the information system.

Storage is the function and services required to save the file information package (AIP).[79] Once the packet of information is received from intake, it is added to storage. The integrity of the storage is ensured by verifying that information received during the transfer has not been corrupted and is error free. Inventory information is continuously sent to administration to aid in the historical management of the storage hierarchy.[80] This storage includes the data management module and sub-processes, such as selection of storage medium, transfer to the storage system, validation, security, backup and data restoration.[81] Storage is done in digital legacy vaults.

Data management works in tandem with storage. It is the area that manages and maintains the database of metadata that identifies and describes the contents of the archive.[82] It updates the information that is entered and produces reports when it modifies or erases any data. Data management generates reports of the various components of OAIS. In the analogue sound file, the database is the tool that manages the metadata obtained from cataloging. It has been observed that with digitization, the ID was integrated as a unique identifier linking the media, or essence, to the catalogue record. Data management in OAIS comprises not only cataloging metadata, but also all metadata obtained during the digital object's lifecycle.

The administration in OAIS consists of the services and functions for the overall operation of the archive system.[83] Administration is responsible for establishing agreements with the producer of the sound document in order to incorporate the information. Administration is the assembly point of the OAIS internal and external interactions (intake, storage of files, management and access to data), and external parties (producers, consumers or users and management).[84] In traditional sound archives, the archive directors or managers have been in charge of the administration tasked designed to detect and

79 Kevin Bradley, Hacia un Sistema…
80 CCSDS, *Reference model for an open archival information system*.
81 Kevin Bradley, Hacia un Sistema…
82 Beedham et al., Assessment of UKDA…, 39.
83 Kevin Bradley, Hacia un Sistema…
84 Beedham et al., Assessment of UKDA…, 34.

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identify collections to be included in the archive, while evaluating the relevance of donation requests, deploying strategies for collecting at-risk documents, and other activities associated with the integration of sound collections. On the other hand, the aforementioned parties have also had the responsibility of attending to information requests and consultation of sound documents.

Planning activities include supervision of the OAIS environment and ensures that the stored data are accessible to the community of potential users and consumers, allowing interaction with these parties and staying abreast of emerging technologies in the field of information and computing platforms.[85] Planning also establishes long-term digital preservation procedures.

Services and functions in the access area are carried out to help users locate and consult stored information and prepares the diffusion of the DIP. Support for users is also a function of access.[86] For a long time, access to sound documents was limited by the fragility of the documents and dearth of required reproduction equipment. With the advent of digitization, the first listening stations in archives allowed for expanded access to and consultation of the sound documents. Moreover, it became possible to consult the catalogue of sound files by internet and create virtual audiotheque networks.[87]

Reliability

A critical aspect of the creation of a digital archive based on OAIS is the institution that is in charge of a digital archive is also responsible for the conservation of and long-term access to the contents preserved. In this order of ideas the *Trusted Digital Repositories: Attributes and Responsibilities* (TDR) was published in 2002, a document establishing the frame of reference for the attributes and responsibilities to ensure that a digital file is reliable, safe and sustainable and that its permanent preservation and indefinite use is guaranteed regardless of the digital information.[88] Some of the attributes established by TDR in accord with OAIS are a viable organization, sustainable funding, adequate technology and procedures, system security, and appropriate data

85 CCSDS, Reference model…
86 *Idem.*
87 Perla Olivia Rodríguez Reséndiz, El archivo sonoro…
88 RLG, *Trusted Digital Repositories: Attributes and Responsibilities*.

preservation policies. [89] A practical version of this document is *Trust Worthy* Repositories Audit and Certification (TRAC): Criteria and Checklist.[90]

Additionally, the principles of a reliable digital repository include the commitment to provide continuity and maintenance of digital objects for users, organizational capacity (financial structure, personnel and processes), acquisition and maintenance of rights and legal liability of archival documents, an effective and efficient regulatory framework, acquiring and incorporating digital objects based on established criteria in accord with their commitments and capabilities; and maintaining and ensuring the integrity, authenticity and ease of use of digital objects over time. These principles also include dissemination of contents, a strategic preservation plan and an adequate technical infrastructure to provide ongoing maintenance and security of their digital objects.[91]

The digital file as a system

The OAIS-based digital sound file can be understood as an open file information system (see *Figure 3*). In this regard, Ojeda stated that the creation of digital audio-visual files is based on a set of integrated systems through which all processes and the life cycle of a digital object are developed for reliable, long-term digital preservation.[92] Additionally, the digital archive conceived on the basis of OAIS as an open file information system is the frame of reference for evaluating the extent to which the current file operations consciously reliably reflect the lifecycles of digital objects in the long term.[93]

OAIS provides the terms and concepts for the long-term preservation of digital objects. Moreover, it identifies the participating actors, describes roles and responsibilities in the digital archive.

All files undergoing the process of digitalization sooner or later shall face definition and commissioning of an digital archive or repository. As such, in accord with the experience of the Netherlands Instituut voor Beeld en Geluid

89 IASA, *Guidelines…*
90 RLG, *Trusted…*
91 Digital Preservation Europe, "DPE Repository Planning Checklist and Guidance DPE- D3.2".
92 Gerardo Ojeda Castañeda, *Los archivos audiovisuales en las redes digitales de comunicación para la educación y la cultura. Informe de Investigación y Documentación Analítica*.
93 Annemieke de Jong, Beth Delaney y Daniel Steinmeier, "OAIS Compliant…".

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and with image and sound in Holland, the identification of OAIS was a relevant action in Media Asset Management (MAM), because it clearly illustrates the application that the requirements could have for digital preservation.

It is recommendable to have the requirements complement each other with different components of the information architecture technology.[94]

The incorporation of OAIS in an archive necessarily involves the diverse areas comprising the normal operation of documentary processes in the sound archive. This means that all personnel participating in the collection, stabilization, conservation, administration, cataloging, dissemination and access with analogical documents must be added to the conception, design and implementation of the digital sound open file information system. The conceptual incorporation of a digital sound open file information system on the basis of OAIS can be the method for approaching the archive personnel in the knowledge and awareness of the conservation and management of digital objects.

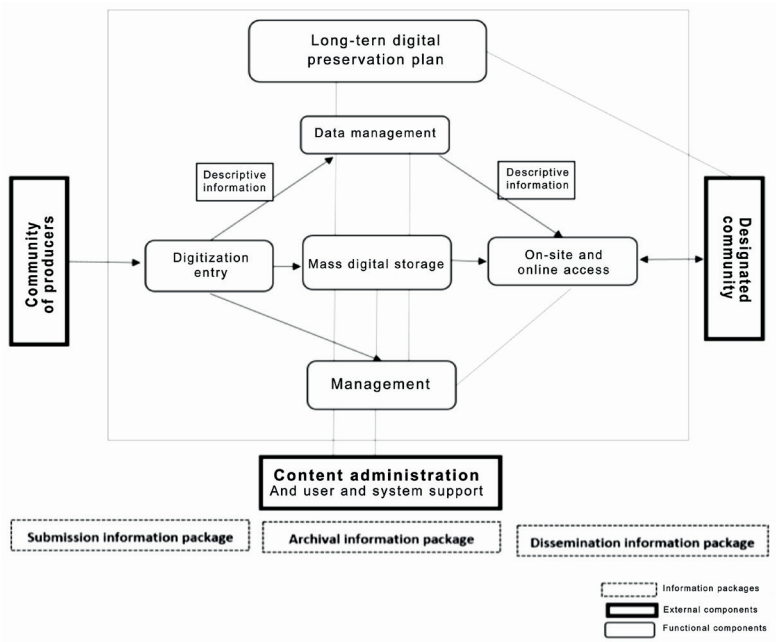

Figura 3. Schematric based on OAIS model

94 *Idem.*

Conclusions

The documentary processes of a sound archive have been modified by the use of digitalization and by the generation and intake of sound documents whose origin is digital. In this situation, the sound document has acquired the form of a digital object formed by two essential components: digital audio, also called essence or media, and metadata. More than two decades ago digital mass storage and management systems emerged as the first digital platforms to manage the digital contents of a sound file. With the growth of digital collections, however, there is a need to have a digital archive or repository model that helps to understand and conceive how to carry out the tasks of reliable, sustainable, long-term preservation of digital sound files that, additionally, are subject to digital preservation risk factors.

Consequently, if digital sound preservation is the sustainable method for permanently conserving, managing, and providing access to digital audio, OAIS is the frame of reference for understanding the nature of the digital object, the components or stages of the life cycle of the digital object and the roles involved in a digital sound file to which the digital sound preservation is applied.

Moreover, OAIS contributes to understanding the transition of the sound document as a digital object on the basis of information packets, a term that incorporates digital sound content and metadata. Information packets participate in the life cycle of the digital object. On the other hand, instead of the documentary processes that are developed in a archive with analogue documents, the digital file exhibits functional components: intake, access, administration, planning, data management and file storage. Likewise, OAIS can identify roles in the interaction and participation of producers or creators of sound documents, the designated community or users, as well as administrators and content managers.

The OAIS provides the basis for the creation of a digital file that is understood as a sound digital information archive system. Through OAIS, files containing digital sound collections can begin to approximate the scheme of operation and functions of a digital archive in which reliable, long-term and sustainable sound digital preservation methods are applied.

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