International Journal of Engineering & Technology, 9 (1) (2020) 12-16

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Need for a digital preservation model based on the administration of digital objects and organizational infrastructure

Fernando Molina-Granja [1] *, Estela Narváez [1], Pamela Buñay [1], Milton López Ramos [1], Diego Reina [1]

[1] Faculty of Engineering, National University of Chimborazo, Riobamba-Ecuador
**Corresponding author E-mail: fmolina@unach.edu.ec*

Abstract

Public entities or institutions that have the responsibility of keeping long-term data, base their processes on digital preservation, involving the application of information technology and activities in the field of information sciences. The digital preservation has historical implications, it has a direct effect on the cultural heritage, because, without information (digital or not) that is guarded, there is no inheritance or culture, but without technology that allows the preservation or recovery of such information, neither would it be, Thus, the research question is posed as: What technical and legal characteristics are necessary to have an adaptive digital preservation model based on aspects of digital object management and organizational infrastructure, to ensure accessibility of information in the long term in public institutions of Ecuador ?, determining through an evaluation of NESTOR trust repositories and Ecuadorian legislation, that it is necessary to create an adaptive digital Preservation model.

Keywords: *Digital Preservation Model; Adaptive Model; PREDECI; OAIS; Digital Object Management; Organizational Infrastructure.*

1. Introduction

Digital preservation (DP) is defined as the processes and actions that contribute to guarantee continuous and indefinite access to information and records that exist in a digital format [1].
The objective of Digital preservation is to overcome the weakness of physical support, technological obsolescence and the vulnerability of the digital medium to guarantee authenticity, integrity, reliability, as well as access followed to information, this being the only way to guarantee and promote the collective and institutional memory.
In the Digital Preservation Guidelines, preservation is defined as actions aimed at maintaining the accessibility of long-term digital objects [2]. In Digital Preservation Coalition - DPC Handbook, it is defined as the activities necessary to ensure continued access to digital materials until necessary, despite the obstacles posed by media failures or technological changes. [3]
In an institution that performs digital preservation processes, if the appropriate technology is not available to support data preservation, such preservation processes cannot be executed. In any case, there is no established generally accepted technological model, although standards and practical criteria have been created. [4]
The relationship between the social, historical, economic and technological implications means that digital preservation obtains recognition as an important area of research, framed in the information and information sciences, due to the informational and technological implications that exist. [5].
This research-based on a bibliographic analysis determines the flaws that current preservation models have and the characteristics that the preservation and archiving process must have in public and governmental institutions in Ecuador, for this study, it is specifically applied in the docuemntal archiving area of the Municipality of Riobamba. . Although all the institutions or organizations that generate information have particular characteristics, we seek to find common factors that allow the model to adapt to a standard preservation process.
This paper is organized in the first instance with an introduction, followed by research methodology, development, and discussion, results, and conclusions. Finally, bibliographic references.

2. Methodology

For the development of this article, the following research methodology is proposed.

2.1. Research question

What technical and legal characteristics are necessary to have an adaptive digital preservation model based on aspects of digital object management and organizational infrastructure, to ensure accessibility of long-term information in public institutions in Ecuador?

2.2. Area

Computing - Digital Preservation Models

2.3. Source

Books, Technical Report, projects and models of digital preservation.

2.4. Search engine

ACM Digital Library, IEEE, Springer

2.5. Search criteria

digital Preservation Model, Public Institutions

2.6. Inclusion criteria

Current models, model analysis, dealing with the management of digital objects and organizational infrastructure.

2.7. Exclusion criteria

that are not models, or that are not in force and that are applicable to the regulations, duplicate documents. For “Public Institutions” in the last 3 years”

2.8. Content evaluation

It must contain the operating characteristics of the model in terms of digital object management and organizational infrastructure.

Applying the Methodology Research you get to the following table of values:

Table 1: Methodology Research Result

Search criteria	SPRINGER Link	IEEE Xplore Digital Library	ACM Digital Library	TOTAL
"digital preservation model"	8	1	3	12
"digital preservation model" for public institutions	25 digital preservation model" AND public AND institutions	37 ((digital preservation model) AND public institutions)	42 (+"digital preservation model" public institutions)	104

Prepared by: The authors.

2.9. Information analysis

From the models analyzed, applying the exclusion criteria in force and that comply with regulations applicable to public institutions in Ecuador, it is determined that the models that comply with the proposed Methodology Research are: PLANETS, OAIS, INTERPARES, DAMM, and PREDECI, and 27 documents for analysis and rationale, as well as 5 laws and regulations in force in Ecuador.
According to NESTOR v2, a catalog of criteria to certify trusted digital repositories-, the current technological environment allows the generation of questions and justifications regarding the reliability of the information. Both generators and consumers of information maintain concern if organizations that preserve information are able to guarantee the authenticity, integrity, confidentiality, and availability of digital information. And, in the face of the inexorable avalanche of digital objects, those responsible for the institutions face the challenge of gaining trust and communication, either to fulfill a legal mandate or simply to survive in the market.
NESTOR and Molina identify the dimensions that allow evaluating the reliability of a digital repository including the model that is applied for the development of the repository, both at a technical and organizational level. [6] [7].
This catalog is a questionnaire structured in four dimensions: A) Organizational infrastructure, B) Administration of digital objects, C) Management of infrastructure and security risks, and D) Management of aspects of integrity in institutions, In this study the dimensions A and B are analyzed with their respective aspects or criteria.
With these considerations, we intend to analyze the compliance characteristics according to NESTOR against the models studied. A NESTOR-based survey was developed with information integrity characteristics whose validation gave a conbranch alpha of 9.25 and which allows the analysis of needs covered by the models analyzed.

3. Contextualization

In this space, an analysis of the existing models and the parameters of their assessment is carried out.

3.1. PREDECI

It is a model of preservation of digital evidence applicable to criminal investigation institutions, which consists of entities that allow its understanding, use, and operation.
PREDECI is especially applicable for the preservation of digital evidence in criminal investigation institutions that have a responsibility to guard it in the long term in order to increase the admissibility of digital evidence in court or the availability of evidence to a communi-

ty designated for the handling of evidence, and guarantees its fidelity and integrity in the long term. It responds to a set of responsibilities determined in laws and regulations for this environment, based on the OAIS preservation model and metadata concepts. [8]
PREDECI has the GLOSSARY Entity, The INGESTA CONTROL functional Entity provides an information input filter, The INGESTA functional Entity, The STORAGE functional Entity, The DATA MANAGEMENT functional Entity, The ADMINISTRATION functional Entity provides the services and functions for the general operation of PREDECI, the functional entity PRESERVATION PLAN and the functional entity of ACCESS. In all entities, there is a transversal procedure that records all the activities of operation, intake, storage, inquiries, administration, data management and any activity performed by a user. [8]

3.2. InterPARES

Project of the University of British Columbia. It is intended to develop the essential knowledge for the long-term preservation of digital documents, and provide the basis for standards, policies and action plans that ensure the longevity of these types of materials and that users trust in their authenticity. It has been developed in four phases. [9]
It is a project for the long-term preservation of authentic archival documents in electronic systems. It is currently in the fourth phase [10] [11]. InterPARES aims to develop the essential knowledge for the long-term preservation of authentic records created and maintained in digital form, providing the basis for developing standards, policies, strategies and action plans, capable of ensuring the longevity of this type of material, [12] [13], guaranteeing its authenticity during its active and semi-active life. Its objective is to produce the theoretical and methodological frameworks to develop policies, procedures, regulations, standards, and legislation on digital records entrusted to the Internet, to guarantee public confidence based on evidence of good governance, a solid digital economy and persistent digital memory. [10].

3.3. OAIS

OAIS is a frame of reference that defines the steps that must be followed to preserve and access the documentation of an institution or organization in the long term. [14] [15]
It is an ISO standard that is not an application architecture, that is, it does not specify how to do it. It provides a reference scheme describing the fundamental functionalities and types of information necessary to permanently preserve a digital information system [16].
The OAIS model was initially designed for use within the scientific community of space, with the objective of digitally conserving data from space missions [15]. However, it has been widely adopted by libraries, especially those of those countries that have participated in its development [17] such as the United States Library of Congress, the British Library, the German National Library or the National Library of New Zealand, which was the pioneer in implementing it [18]. This is why the OAIS model has wide applicability for long-term preservation in any context.
Obviously, in order to implement the OAIS model to an institution where resources are limited, its adaptation must be used to facilitate its applicability and financial sustainability. Therefore, it is essential to find out, in others, the characteristics of the environment, the training of its personnel or the security of its data. The main objective of this study is precisely this, to propose the adaptation of an OAIS model that can be applied to management entities in criminal investigation institutions for the preservation of evidence.
The OAIS model incorporates technological surveillance, digital preservation and all the processes that require digital documents to have a data center that cannot be altered, modified or lost. Its functions are Ingestion, Storage, Data management, Access, Preservation, Common services

3.4. Digital archiving maturity model- DAMM

Organizations are realizing that it is critical for the business to archive digital information for several years. Ensuring that archived information can be accessed when the need arises is key, as is creating value from archived assets. However, the term "Digital Archive" is used to cover many different types of solutions to this problem. [19].
The term Maturity Model is used to imply layers of sophistication in the processes, the first of which must be completed before moving on to the next. This is true for Digital Preservation - it makes no sense to have an intelligent information management system if you don't have secure storage. [19].
The Digital Accessibility Maturity Model defines a working model to measure the maturity of digital accessibility programs. To achieve this, DAMM also includes a series of dimensions, aspects, artifacts and levels that support the model. [20]

3.5. Planets

Preservation and Long-term Access through Networked Services, is a project initiated in 2006 for a period of four years and funded by the European Union within the VI Framework Program with the mission of addressing the challenges of digital preservation. The first objective for Planets is to build practical services and tools to help ensure long-term access to a cultural and scientific heritage that exists in electronic format. [21] According to his presentation, it creates a sustainable framework to allow the preservation of digital content, in order to increase European capacity to ensure access to your digital information in perpetuity [22] [21]

4. Results

After the literature review, it is determined that the existing models analyzed do not fully comply with the preservation needs, specifically in the management of digital objects and organizational infrastructure. In table 2 and table 3, the assessment obtained can be evidenced.
the DIGITAL OBJECT MANAGEMENT aspect evaluates whether the analyzed model allows identifying the content information and the properties of the information that the model preserves;
the PRESERVATION PLANNING aspect, assesses whether the analyzed model allows conservation strategies corresponding to their shares to be documented;
The PRESERVATION OF THE AIP aspect, evaluates whether the analyzed model makes it possible to have specifications on how the AIPs are stored up to the bit level;

The INFORMATION MANAGEMENT aspect assesses whether the analyzed model allows specifying the minimum information requirements to allow the designated community to discover and identify the materials of interest;
The ACCESS MANAGEMENT aspect assesses whether the analyzed model allows compliance with access directives.
According to Ecuadorian legalization, 5 documents are analyzed, which will be referred to as follows. NT1: Law on the national public data recording system, [23] NT2: Document management standard for public administration entities, [24] NT3: National technical rule for organization and aintenance of public files [25] , NT4: Technical document and archive management standard [26], NT5: System Regulation Archives of the Higher Education Council. [27]
For the tabulation of results, the following rating scale is used to measure compliance with the digital preservation characteristics of the models analyzed: 1: Does not comply, 2: Partially complies, 3: Fully complies.
And the following scale of assessment to determine the requirement of the law of digital preservation characteristics in the Ecuadorian legislation analyzed: 1: Does not require the law, 2: The law recommends, 3: The law requires Fully Complies

Table 2: Assessment of Compliance of the Models in Terms of Administration of Digital Objects

DIMENSION: DIGITAL OBJECT MANAGEMENT										
	ANALYZED MODELS					ECUADORIAN LEGISLATION				
ASPECT	PLANETS [22]	OAIS [15]	INTERPARES [28]	DAMM [29]	PREDECI [8]	NT1	NT2	NT3	NT4	NT5
Digital object management	3	3	1	1	2	2	3	2	3	3
Preservation planning	3	3	2	2	2	2	3	3	3	3
Preservation of the AIP	1	3	1	1	3	1	3	1	1	3
Information management	3	3	3	2	3	1	3	2	3	3
Access management	3	3	3	3	3	2	1	1	3	3
Total	13	15	11	11	13	8	13	9	13	12
Percentage	86,67%	100,00%	73,33%	73,33%	86,67%	53,33%	86,67%	60,00%	86,67%	80,00%

Prepared by the authors.

Table 2 shows high compliance between 73% and 86.67% of the preservation models in relation to the aspects evaluated, showing that the OAIS, PLANETS and PREDECI model meets most of the requirements of preservation, however, with the study with the legal obligation of the requirements. It is determined that no model fully meets the requirements of Ecuadorian legislation, the legal requirements required by law. None of the models do comply in some cases completely and in other cases with partial compliance. This evidently indicates that it is necessary to generate a new adaptive model that fully complies with these mandatory aspects.
The GOVERNANCE AND ORGANIZATIONAL VIABILITY aspect assesses whether the model allows for a mission that reflects the commitment to the preservation and long-term retention of, management and access to digital information;
The ORGANIZATIONAL AND PERSONAL STRUCTURE aspect, assesses whether the analyzed model allows to identify and establish the functions that are needed to carry out the assigned tasks and have appointed personnel with adequate preparation and experience to fulfill these obligations;
The FRAMEWORK OF ACCOUNTABILITY AND PRESERVATION POLICY PROCEDURES, assesses whether the analyzed model allows to define its designated community and has these definitions accessible. This is necessary to know if the model meets the needs of your designated community;
The FINANCIAL SUSTAINABILITY aspect assesses whether the model analyzed allows for financial practices and procedures that are transparent, complies with the relevant accounting standards and practices and audited by third parties in accordance with territorial legal requirements;
The CONTRACTS, LICENSES AND PASIVES aspect assesses whether the analyzed model allows for the availability of appropriate contracts or agreements for digital materials that are managed, conserved, or to which access is provided.
In the organizational infrastructure dimension, the following assessment is obtained:

Table 3: Assessment of Compliance of the Models in Terms of Organizational Infrastructure

DIMENSION: ORGANIZATIONAL INFRASTRUCTURE										
	ANALYZED MODELS					ECUADORIAN LEGISLATION				
ASPECT	PLANETS [22]	OAIS [15]	INTERPARES [28]	DAMM [29]	PREDECI [8]	NT1	NT2	NT3	NT4	NT5
Governance and organizational viability	3	3	3	3	3	2	3	2	3	3
Organizational and personal structure	2	3	3	2	3	2	3	3	2	2
Framework of accountability and preservation policy procedures	2	3	3	1	2	2	3	3	3	3
Financial sustainabilit	1	1	3	1	3	3	3	3	3	3
Contracts, licenses and pasives	1	1	3	3	3	1	2	2	3	2
Total	9	11	15	10	14	8	12	12	14	11
Percentage	60,00%	73,33%	100,00%	66,67%	93,33%	66,67%	93,33%	86,67%	93,33%	86,67%

Prepared by the authors.

Table 3 shows the majority compliance of two models, the INTERPARES model with 100% compliance, and the PREDECI model with 93.33% compliance, while the other models fluctuate between 60% and 73.33% of compliance in relation to the aspects evaluated, however, with the study with the legal obligation of the requirements, it is determined that, in the same way, no model fully meets the requirements of Ecuadorian legislation, thus, the legal requirements that it requires the law but that do not meet the models in some cases completely and in other cases with partial compliance. This evidently indicates that it is necessary to generate a new adaptive model that fully complies with these mandatory aspects.

5. Conclusion

It is concluded that no model analyzed completely complies with the technical or legal characteristics to preserve digital data in public institutions, some models meet some characteristics and other models other characteristics.
It is necessary to generate an adaptive model of Digital Preservation based on aspects of organizational infrastructure and administration of digital objects, applied to public institutions in Ecuador.
The research question posed is answered by clearly determining and specifying in the analysis of Table 2 and Table 3, that there are several aspects of the "Organizational Infrastructure" and "Digital Object Management" dimension, which is not met by the Models analyzed and that is required by law, these are: Preservation planning, AIP preservation by an side, and an organizational and personal structure, the accountability framework and preservation policy procedures, financial sustainability, contracts, licenses and pasives on the other side.

6. Future works

Analyze compliance with the technical characteristics of digital preservation in other dimensions or aspects required in different application environments.
Create an adaptive digital preservation model applied to public institutions in Ecuador.

References

[1] A. a. M. v. D. Van der Merwe, "Planning an effective digital preservation from a research organization," 2009. [Online]. Available: http://www.ais.up.ac.za/digi/docs/avdmerwe-paper.pdf.
[2] UNESCO, "Carta sobre la preservación del patrimonio digital. Actas de la Conferencia General," Paris, 2004.
[3] Digital Preservation Coalition, "Preservation Management of Digital Materials: The Handbook," Digital Preservation Coalition, Glasgow, 2008.
[4] W. LeFurgy, NDIIPP partner perspectives on economic sustainability, Library Trends 413-426, 2009. https://doi.org/10.1353/lib.0.0044.
[5] J. L. John, the future of saving our past. Nature, 459(7248), 775-776., Published Digital Preservation Coalition in association with Charles Beagrie Ltd., 2009. https://doi.org/10.1038/459775a.
[6] Nestor working Group, Catalogue of Criteria for Trusted Digital Repositories. Version 2, Frankfurt: Nestor working Group Trusted Repositories - Certification, 2009.
[7] F. Molina and G. Rodriguez, "The preservation of digital evidence and its admissibility in the court.," nt. J. of Electronic Security and Digital Forensics., vol. 9, no. 1, pp. 1-18, 2017b. https://doi.org/10.1504/IJESDF.2017.10002624.
[8] F. Molina and G. Rodriguez, "MODEL FOR DIGITAL EVIDENCE PRESERVATION IN CRIMINAL RESEARCH INSTITUTIONS – PREDECI," Int. J. of Electronic Security and Digital Forensics, vol. 9, no. 2, pp. 150-166, 2017. https://doi.org/10.1504/IJESDF.2017.10004412.
[9] The International Research on Permanent Authentic Records in Electronic Systems, "The InterPARES Project," 2013. [Online]. Available: http://www.interpares.org/. [Accessed 5 10 2014].
[10] A. Jansen and L. Duranti, "The InterPARES Trust Project–Trust and Digital Records in an Increasingly Networked Society," THE FUTURE OF INFORMATION SCIENCES, p. 63, 2013.
[11] L. Duranti, "An overview of InterPARES 3 (2007-2012)," Archives & Social Studies, 1(1),, pp. 577-603, 2012.
[12] L. Duranti, "The InterPARES 2 Project (2002-2007): An Overview." Archivaria 64, pp. 113-121., 2007.
[13] L. Duranti and R. Preston, International research on permanent authentic records in electronic systems (InterPARES) 2: Experiential, interactive and dynamic Records, Padua: CLEUP Padua, Italy, 2008, pp. 34-35.
[14] F. Molina and G. Rodriguez, "Digital Preservation and Criminal Investigation: A Pending Subject," in New Contributions in Information Systems and Technologies, United State, Springer International Publishing, 2015a, pp. pp 299-309. https://doi.org/10.1007/978-3-319-16486-1_30.
[15] Consultative Committee for Space Data Systems, Reference Model for an Open Archival Information System (OAIS) 650.0-M-2, Washington, DC, USA: CCSDS, 2012.
[16] R. C. Cruz, "Sistema de Información de Archivo Abierto (OAIS): luces y sombras de un modelo de referencia," Investigación bibliotecológica: archivonomía, bibliotecología e información, vol. 30, no. 70, pp. 221-247, 2016. https://doi.org/10.1016/j.ibbai.2016.10.010.
[17] D. Woodyard, "The OAIS experience at the British Library. ERPANET OAIS Training Seminar," 2002. [Online]. Available: http://www.erpanet.org>. [Accessed 18 agosto 2015].
[18] G. Knight, "InSPECT Framework Report," The National Archives, London, 2009.
[19] Tessella, "Digital Preservation Maturity Model - White Paper," 2013.
[20] F. Molina and G. Rodriguez, "Preservation of Digital Evidence: Application in Criminal Investigation," in Science and Information Conference., London, United Kingdom., 2015b.
[21] Open Planets Foundation, "PLANETS," 2007. [Online]. Available: http://www.planets-project.eu.
[22] Open Planets Foundation, "PLANETS - PRESERVATION AND LONG-TERM ACCESS THROUGH NETWORKED SERVICES," 31 mayo 2010. [Online]. Available: http://planets-project.eu/. [Accessed 23 12 2014].
[23] Asamblea Nacional Del Ecudador, "http://www.datospublicos.gob.ec," 12 09 2014. [Online]. Available: http://www.datospublicos.gob.ec/wp-content/uploads/downloads/2017/05/LEY-ORGANICA-DEL-SISTEMA-NACIONAL-DE-REGISTRO-DE-DATOS-PUBLICOS.pdf. [Accessed 16 10 2019].
[24] Secretaria nacional de la administracion publica, "norma de gestion documental para entidades. De administracion publica," registro oficial suplemento 445 de 25-feb. -2015, quito, 2015.
[25] Secretaria nacional de la administracion publica, "norma tecnica de gestion documental y archivo," secretaria nacional de la administracion publica, quito, 2015.
[26] Secretaria general de la presidencia de la republica, "regla técnica nacional para la organización y," secretaria general de la presidencia de la republica, quito, 2019.
[27] Consejo de educacion superior, "reglamento del sistema de archivos del consejo de educación superior," consejo de educacion superior, quito, 2016.
[28] The interpares project, "digital records pathways: topics in digital preservation. module 3: organizational culture and its effects on records management," interpares / ica, usa, 2012.
[29] S. byrne-haber, "the digital accessibility maturity model: damm audit – final reporting and follow-on activities," level access, 2 09 2015. [Online]. Available: https://dev-level-access.pantheonsite.io/the-digital-accessibility-maturity-model-damm-audit-final-reporting-and-follow-on-activities/. [Accessed 1 10 2019].