The role of digital preservation in digital curation

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CHAPTER 7

THE ROLE OF DIGITAL PRESERVATION IN DIGITAL CURATION

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ABSTRACT

Currently, information has been increasingly produced in digital format, thus new ways of preserving and providing access on its features are required. Preserving digital information against constant changes and advances as well as ensures its veracity is the current challenge. The digital preservation field is multidisciplinary and involves some aspects, such as: technical – related to the selection of what is necessary to be preserved, the use of models and standards, setting up technological infrastructure for preservation and access, application of the appropriate strategies, proper support usage, and metadata representation; organizational – related to management activities; legal – dealing with copyright issues, laws, rules and recommendations; cultural – related to the ability to assimilate changes that digital preservation generates in the entire informational process. This chapter presents the concepts that substantiate digital preservation, detail their aspects and show how they are related to Digital Curatorship life cycle.

Keywords: Digital preservation, digital object, organizational culture, Digital Curation.

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RESUMEN

La información ha sido producida cada vez más en forma digital y sus características demandan nuevas formas de preservar y proporcionar su acceso. El desafío actual es cómo preservar la información digital ante los cambios y avances constantes, garantizando su autenticidad. El campo de la preservación digital es multidisciplinar e involucra aspectos: técnicos, relacionados con la selección de lo que preservar, la utilización de modelos y estándares, el montaje de la infraestructura tecnológica de preservación y acceso, la aplicación de las estrategias adecuadas, al uso del soporte adecuado y la representación por metadatos; organizacionales, relativos a las actividades de gestión; legales, que tratan de cuestiones como derechos de autor, leyes, normas y recomendaciones; culturales, relacionados con la capacidad de asimilación de los cambios que la preservación digital genera en todo el proceso informacional. Este capítulo presenta los conceptos que fundamentan la preservación digital, detalla sus aspectos y cómo estos están relacionados con el ciclo de vida de la Curación Digital.

Palabras clave: Preservación digital, objeto digital, cultura organizacional, curación digital.

1 INTRODUCTION

Information, especially since the emergence of the Internet, has been increasingly produced digitally. Digital information presents features that demand new ways of preserving and providing access to it in the face of new challenges, such as changes in formats, supports, software and hardware, produced volume and access mechanisms. One of the current challenges is how to preserve and maintain access to digital information in the face of constant changes and advances, ensuring its authenticity and integrity.

Digital information is part of the historical and cultural heritage, and providing its continuous access is deemed necessary as it means maintaining the memory of people and institutions, in addition to meeting legal requirements. Digital information is recorded in digital objects, which have their own specificities and must be preserved in the face of innovations and advances in information and communication technologies. The digital preservation of these digital objects must consider their entire lifecycle, that is, from production, storage, processing, use and destination.

This chapter aims at presenting the concepts underlying digital preservation, its elements and the processes involved in its implementation, and how they are inserted in Digital Curation.

2 DIGITAL PRESERVATION

The concept of Preservation had its international diffusion around 1930, when an attempt to standardize global practices and actions for the preservation, especially, of the most significant monuments and buildings for the collective interest. “Thus, in the 1930s, “preservation” was equivalent to protecting monumental architecture for the future” (Sant’anna, 2015, p. 3, our translation).

In 1972, UNESCO launched a normative instrument resulting from the Convention Concerning the Protection of World Cultural and Natural Heritage, held in Paris in November 1972. With this expanded concept, Preservation is now proposed for various areas, from natural and urban landscapes to human tangible and intangible actions and products (Sant’anna, 2015).

Thus, the concept of preservation expands to "a set of measures and strategies of an administrative, political and operational nature that directly or indirectly contribute to the preservation of the integrity of the materials" (Cassares, 2000, p. 12, our translation).

Conway (2001) corroborates this understanding by claiming that "The essence of preservation management lies in resource allocation. People, resources and materials must be required, organized and put into practice to ensure adequate protection of information sources" (Conway, 2001, p. 14, our translation)

As one of the preservation strategies, it was initiated, from the development of digital technologies, mainly in the last decade of the 20th century, actions that allowed the digitization and availability of collections with the most varied supports, from various institutions worldwide. Even in the simple digitization process, it must be recognized that "Preservation management digital images in archives includes the generation, organization and indexing, storage, transmission and ongoing maintenance of intellectual integrity" (Conway, 2001, p. 23, our translation).

A big step towards greater concern and discussions about Preservation on digital environment was given by UNESCO, in 2003, when it published the Charter on the Preservation of Digital Heritage, highlighting the need to maintain the digital object with strategies throughout its life cycle.

> Continuity of the digital heritage is fundamental. To preserve digital heritage, measures will need to be taken throughout the information lifecycle, from creation to access. Long-term preservation of digital heritage begins with the design of reliable systems and procedures which will produce authentic and stable digital objects. (Unesco, 2003, Article 5).

Therefore, Digital Preservation is beyond making backup copies of digital objects. Despite being an important element for digital preservation, storage and restoration solutions are not sufficient technical actions to ensure preservation, search, retrieval and access to digital objects with authenticity warrant.

Unesco defines Digital Preservation as

> processes aimed at ensuring the continued accessibility of digital materials. To do this involves finding ways to re-present what was originally presented to users by a combination of software and hardware tools acting on the data. (Unesco, 2019, n. p.).

Ferreira (2006) adds that Digital Preservation

> consists of the ability to ensure that digital information remains accessible and with sufficient authenticity qualities so that it can be interpreted in the future using a different technological platform from the one used at the time of its creation. (p. 20, our translation).

Grácio (2012) defines Digital Preservation as

> management processes involved in the administration of necessary activities to ensure that a digital object can be accessed and used in the future, based on the ICTs existing at the time, and with guarantees of its authenticity and integrity. (p. 61, our translation).

In this context, a digital object is "any and every information object that can be represented through a sequence of binary digits", accommodating both born-digital objects and those generated from analog supports (digitization). As examples, we can mention text documents, digital photographs, audiovisuals, audio, databases, Web pages, e-mail messages, research data, among others (Ferreira, 2006, p. 21, our translation).

In this way, Digital Preservation must be inserted in the entire life cycle of the digital object and in the management processes. Consequently, it involves several areas and several professionals of an institution, who must be included in the management processes to ensure the digital objects' preservation and access (Grácio, Troitiño, Madio, Brega, & Moraes, 2020, p. 568).

Faced with changes and advances in Information and Communication Technologies (ICTs) and the obsolescence of file formats, hardware and software, which have accelerated with the Internet, digital object preservation depends on defining when and what

actions must be taken on these objects to maintain them preserved, accessible and authentic.

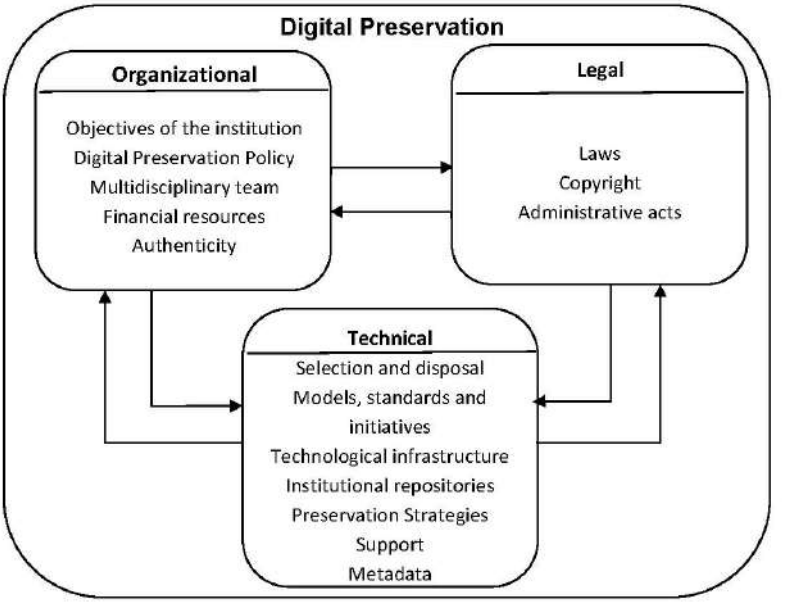
These changes in ICTs affect institutions, which we highlight, are not only formed by pre-defined hierarchical structures and shaped by legislation and norms, which determine their dynamics and functioning, but are also constituted by their employees, who weave a daily network of bonds, practices and knowledge, permeated by their personal and collective aspects and experiences, determinant in the formation of mental models and paradigms, which result in a specific social and historical construct. All these dimensions, ultimately, form the organizational culture, which will always be unique, as it adjusts to the intrinsic characteristics of this universe, specific to each of its members, and at the same time, to this collectivity.

We have observed that any incorporation, change or reduction in this specific community will cause a great impact and resistance in the adoption of new proposals is often seen. Grácio (2012) highlights that

> In the same way that the organizational culture needed time to be built, sedimented and assimilated by the institution's members, the changes arising from digital preservation also need time. It takes time for people to adapt to the new structure and to inserted it into the organizational culture, as digital preservation belongs to a context of constant advances, changes in the case of digital preservation will occur frequently. However, as soon as digital preservation is inserted in the organizational culture, advances can be assimilated by the institution with greater speed and acceptance. (p. 45, our translation).

As it is a multidisciplinary field, digital preservation involves, in addition to issues related to ICTs and the change in organizational culture, organizational, legal and technical elements, as shown in Figure 1:

Figure 1: Digital Preservation Elements



Source: Grácio, Troitiño, Madio, Brega, & Moraes (2020, p. 570, our translation).

The organizational elements are those related to the institution's management activities and "seek to provide organizational support to continue Digital Preservation activities, regardless of changes that may occur in the institution's management, available financial resources or policies" (Grácio, 2012, p. 83, our translation).

They are related to: 1. the duty to include digital preservation in the institution's objectives so that all the involved processes have institutional support; 2. the definition of a Digital Preservation Policy (DPP), to continue digital preservation activities, which must be aligned with the institution's objectives and with other institutional policies; 3. the formation of a multidisciplinary team to manage the processes, activities and people involved in digital preservation; 4. the indication of responsibilities, both sectoral and individual; 5. the permanent obligation to invest in technology, infrastructure and qualified personnel; 6. the need for actions to ensure digital object

authenticity.

The legal elements are related to legal issues such as copyright and the need to define the processes following norms, laws and recommendations that govern digital objects, whether these are international or national norms, which must be complemented by internal acts when necessary. Thus, legitimate digital preservation processes are ensured for the institution and for the creator of the digital object.

The technical elements, in turn, are related to issues involved in computer science, library science, archival science and other related activities. They involve questions such as:

> the selection of what to preserve and what to dispose; the use of models and standards; participation in national and international initiatives that allow exchanging experience and knowledge between institutions; the assembly of the technological infrastructure for the preservation and access to preserved digital objects; the application of appropriate digital preservation strategies; the use of adequate support; and metadata representation. (Grácio, Troitiño, Madio, Brega, & Moraes, 2020, p. 570-571, our translation).

The use of models is essential to standardize the processes involved in digital preservation. The Open Archival Information System (OAIS) is the most cited reference model in the literature and the most adopted for digital preservation solutions. The model is detailed in ISO 14721:2012, which is currently in its 2nd version. In Brazil, it was published in 2007 as ABNT NBR 15472:2007. Its objective is to define and model what is needed to "to develop a system for storage, preservation and access to digital information, and is widely used to develop digital preservation systems" (Grácio, Troitiño, Madio, Brega, & Moraes, 2020, p. 571, our translation). Digital objects and their metadata travel through the model through information packages.

We recommend establishing partnerships and participation in digital preservation initiatives that enable exchanging information and experiences between institutions and professionals responsible for digital preservation processes, whether in technical, legal,

organizational or cultural aspects, helping and optimizing the processes for implementing digital preservation.

Metadata are elements that describe a digital object for its search, retrieval and preservation. They can be descriptive, administrative, technical, structural or preservation. They are essential to assist in proving digital object authenticity, in addition to enabling its search and retrieval. Preservation metadata records all strategies applied to the digital object during its life cycle. An example of preservation metadata is the PREMIS Data Dictionary for Preservation Metadata (Caplan, 2017).

Digital Preservation must cover the entire life cycle of digital objects, from their creation[1], treatment, storage, access and maintenance, involving different actors such as the digital object creator, the institution that maintains them, the technical personnel and their users, going beyond the simple use of tools and software for its preservation.

The implementation of Digital Preservation by an institution depends on the definition of a Digital Preservation Policy (DPP), an action plan and the processes involved to its implementation, which must include ICTs, organizational culture and organizational, legal and technical elements.

A DPP can be defined as:

> a document that defines the objectives and guidelines for the implementation of a preservation program of an institution's records and digital objects. This policy must be aligned with the objectives and other institutional policies in force and be revised over time, covering all elements related to digital preservation, including those related to organizational culture and changes in ICTs. (Grácio, Troitiño, Madio, Brega, & Moraes, 2020, p. 569, our translation).

In this sense, the DPP does not define the specific activities, as this role belongs to the Digital Preservation action plan, which define the procedures, operations and those responsible for the execution of the DPP part or whole.

1 Creation is understood for both scanned and born-digital documents.

According to ICA/InterPares (2017) a Digital Preservation plan

> are the actions established to allow the theory to be put into practice. Because they are context-specific, they change more often than the policy, so it is easier to modify them as needed. Procedures can be developed within an organization to support the policy and reflect the organization's specific needs and requirements. (p. 18-19).

Process management requires a multidisciplinary team, which will be the body responsible for planning, drafting standards, defining responsibilities and structuring the institution's areas for activities related to Digital Preservation. This team should be composed of professionals in the areas of digital preservation, institution management, information technology (IT), law, archival science, librarianship, museology, information science, among others.

The use of procedural information management models helps in the process implementation. The model aims to ensure that all processes involved in Digital Preservation are identified, detailed and possible to be implemented.

For Santos (2016):

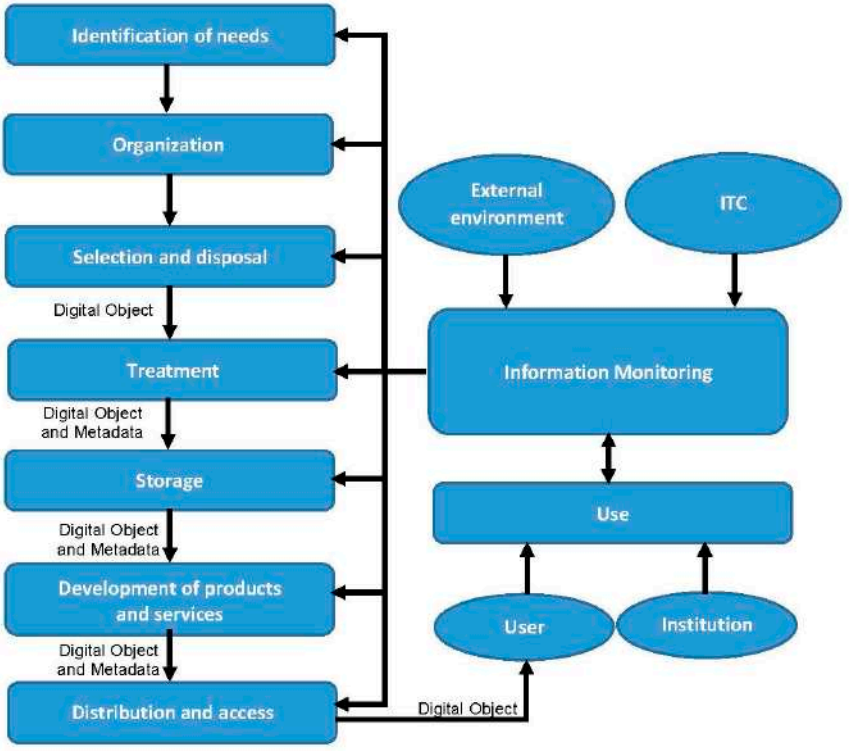
> the search for a model of information representation that includes creation, appraisal, transformation and access points out that the interest of preserving information in digital media goes beyond the creation and use of systems that meet specific preservation aspects. (p. 455, our translation).

A model with the processes involved in Digital Preservation activities named Procedural Model of Digital Preservation, proposed by Grácio (2012) is presented below. The model is cyclical and defines a set of related processes that enable the long-term preservation of digital objects. As it is a generic model, it can be adapted to any type of digital object and in any institution.

The model is composed of processes, entities and flows. The Processes deal with the actions and elements involved in digital preservation and are represented by rectangles with rounded corners;

Entities are users (internal or external), institutions (Organizations, Educational Institutions, etc.) or situations (ICTs, external environment, culture, etc.) that may, for some reason, interfere with the processes, and are represented by ellipses.

Figure 2: Digital Preservation Procedural Model



Source: adapted from Grácio (2012).

The institution must be aware of the changes and innovations that occur in ICTs, anticipating the problems affecting digital preservation, applying the necessary preservation strategies and training and motivating the multidisciplinary teams involved in the

processes.

The organizational culture permeates all processes, including the decision, valuation and acceptance ones of the model as it involves existing people and groups in the institutions.

In that regard:

> the model must be structured and assembled with a vision and a way of acting agreed between individuals and their groups, based on elements of the organizational culture and on the defined objectives for the processes involved in digital preservation. (Grácio, 2012, p. 164, our translation).

Process management requires the definition of a normative multidisciplinary team (NMT) and executive multidisciplinary teams (EMT).

The NMT will be responsible for managing the processes and ordering activities within the institution. Its main competencies are

> [...] to set up the necessary management structure within the institution for activities related to digital preservation; define the norms, policies and standards to be adopted and revise them when necessary; define personal and institutional responsibilities; carry out budget planning; identify and define the digital objects to be preserved; define selection, disposal and maintenance criteria; manage and monitor the processes; point out guidelines and criteria to be used in the processes; establish partnerships with other institutions; prepare proposals to be presented to the institution's management bodies; create the EMTs. (Grácio, 2012, p. 165, our translation).

The EMTs are working groups responsible for carrying out the activities established in the processes, with specific functions and technical knowledge. They may as main competences

> [...] define the temporality tables; apply defined metadata templates and standards; define the way institutional repositories work; define the appropriate

> supports for each type of digital object; define appropriate strategies for preservation activities; define the necessary technological infrastructure; develop the products and services; adapt distribution and access to existing infrastructure. (Grácio, 2012, p. 165-166, our translation).

Each of the processes is detailed, according to Grácio (2012).

• *Identification of needs*

The identification-of-needs process aims at recognizing which digital objects are the responsibility of the institution, which must be preserved, according to the historical, cultural and legal needs of this organization and its users. It has a direct relationship with the DPP, the institution's objectives and with the organizational culture, as the digital objects to be preserved and, consequently, made available, depend on the information that the institution produces.

• *Organization*

The organization process must deal with the technical infrastructure and personnel, which will meet the technical needs aiming at creating an adequate technological environment for digital object preservation and access. It includes technical training, investment in the necessary infrastructure for storage and access, hardware and software upgrades, computer network upgrades and their services, infrastructure and information security, among others.

• *Selection and disposal*

From the identification-of-needs process, the selection and disposal process aims at defining the priorities of the digital objects to be preserved, their storage time and which ones should be disposed, based on the institution's objectives, the needs' appraisal and the legal criteria pointed out by the multidisciplinary team. Selection and disposal should reflect the institution and users' information needs.

• *Treatment*

The process of treating digital objects is related to metadata description and must be carried out by trained professionals such as librarians and archivists, following standards defined by the multidisciplinary team, which also defines, for each type of digital object, which metadata must be used. The use of standards enables and facilitates interoperability between systems. Metadata can be descriptive, administrative, technical, structural, or preservation.

• *Storage*

The storage process aims at inserting the digital object and its metadata into the technological infrastructure to meet the demand of institutions and users, in the object preservation, search, retrieval and access. Storage must meet two infrastructures: preservation, aiming at storing the digital objects to be preserved and their metadata; and access, to store the digital objects that meet the users' research needs.

• *Development of products and services*

Once the digital objects to be preserved are correctly organized, stored and described, the product and service development process creates and provides an environment for searching and retrieving digital objects in the access infrastructure.

• *Distribution and access*

The access process aims to verify users' access privileges to preserved digital objects, define access formats and generate the information package to be forwarded to the user. Distribution defines how the object will be forwarded to the user using efficient communication channels. The activities involved in the distribution and access process must be in line with products and services as both deal with the main focus of digital preservation, which is the user.

• *Use*

The use process is the stage of process and model appraisal, verifying if the digital objects, products and services are adequately serving the institution and users (internal and external). The appraisal of preserved digital object use within an institution can be carried out in several ways, among them, automatically seeking quantitative information from the systems and services available or through surveys with product and service users.

Access to preserved digital objects by users is the main objective of digital preservation and in this sense the use process is treated as a separate process due to its importance and its strong relationship with the information monitoring process.

• *Information monitoring*

The monitoring process is responsible for monitoring and constantly adapting the processes that comprise the model, in view of the needs of the entities involved in the model (User, institution, ICTs and External Environment), a continuous and dynamic process, which allows pointing out the best solutions for digital preservation within the institution. This process must be managed by a multidisciplinary team that decides on the necessary adjustments to the processes.

3 DIGITAL PRESERVATION IN DIGITAL CURATION

To ensure digital object preservation and access, their management throughout their life cycle is necessary. In this sense, the concept of digital curation emerges, which according to Silva and Siebra (2017, p. 2, our translation) "intends to support digital object reproducibility and reuse as well as their preservation, authenticity and integrity".

Abbott (2008) defines digital curation as:

> the long-term management and preservation of digital data. All activities involved in managing data from planning its creation, best practices in digitization and documentation, and ensuring its availability and suitability for discovery and reuse in the future are part of digital curation. (n.p.).

Digital curation has the following objectives (Abbott, 2008) in relation to digital data: to ensure long-term sustainability; to improve the quality of data and its context by adding value to it; to use common standards in different data sets; to improve reliability; to facilitate persistent access to trusted digital data; to ensure that they can be used in the future as legal evidence and that they are available for use and reuse; to preserve and protect them against loss and obsolescence; to provide information on context and provenance; to use tools and services to migrate data, metadata and other representational information to new formats.

Several initiatives have emerged to study solutions for digital curation and one of them is the Digital Curation Center (DCC), launched in the UK in 2004, "to help solve digital curation and long-term preservation challenges that could not be tackled effectively by any single institution or discipline" (DCC, 2021, n.p.), focusing on managing research data.

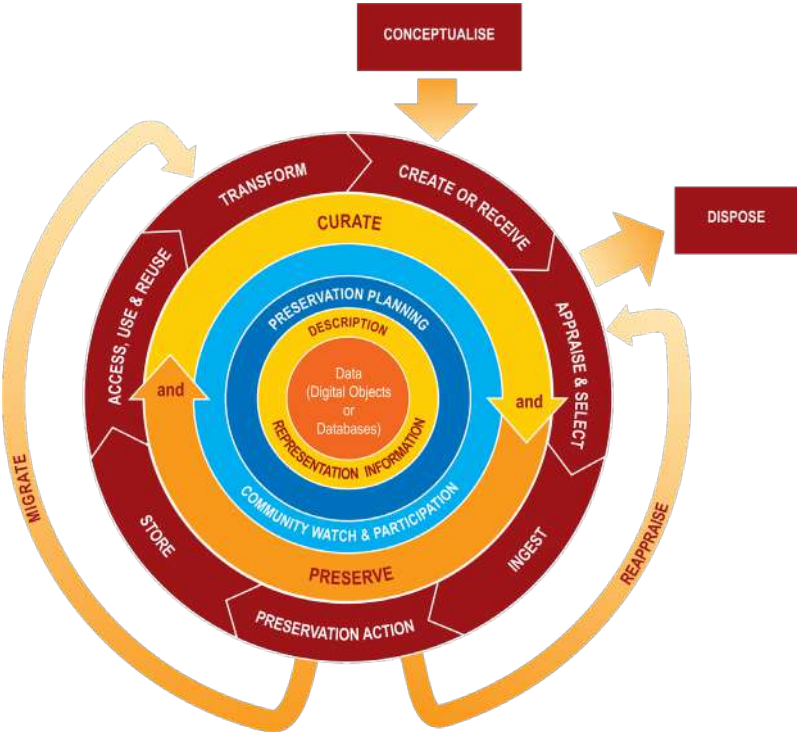
The DCC defines digital curation as:

> the long-term management and preservation of digital data/information. It involves maintaining, preserving and adding value to digital research data throughout its lifecycle, increasing the value of existing data by making it available for future high-quality research. (DCC, 2021, n.p.).

DCC has published the Digital Curation Lifecycle Model, a model aimed at curating research data, but which can be suitable for any type of digital object. For DCC a digital object is one composed of a bit string.

The model graphically provides a high-level overview of the life cycle stages required for successful curation. In that regard, "it can be used to: define roles and responsibilities; build frameworks of standards and technologies; and ensure that processes and policies are adequately documented" (Higgins, 2008, p. 135). Figure 3 presents this model.

Figure 3 - DCC's digital curation lifecycle



Source: DCC (2021, n.p.).

At the center of the model are the data, defined as any information in binary code, and include the digital objects and database. Around the data are the actions classified into: for the entire life cycle, present during the entire life cycle of the digital object; sequential, which need to be fulfilled, repeatedly, in a cyclical way, forming the bases of the curation chain; occasional, eventually applied due to some decision taken (Sayão & Sales, 2012). Table 1 presents each of the actions.

Table 1: Actions of the DCC's Digital Curation Lifecycle

Actions for the entire lifecycle	
Information description and representation	It involves the attribution of administrative, technical, structural and preservation metadata.
Preservation planning	Related to preservation planning throughout the digital object life cycle.
Community watch and participation	It emphasizes the need for community monitoring and participation involved in digital curation.
Curate and preserve	Be continually alert and undertake planned administrative and management actions for curation and preservation throughout the curation lifecycle.
Sequential Actions	
Conceptualize	Design and plan data creation, including capture methods and storage options;
Create or receive	Create data, including metadata, and receive it according to pre-defined policies.
Appraise and select	Appraise the data and select what will be the object of curation and long-term preservation processes according to policies and legal requirements.
Ingest	Transfer the data to an archive, or repository, or data center or other appropriate custodian.
Preservation action	Undertake actions to ensure long-term preservation and retention of official data, ensuring that data remains authentic, reliable and usable, while maintaining its integrity.

Store	Store data securely while maintaining adherence to relevant standards.
Access, use and reuse	Ensure that data can be accessed both by your target community and by other users interested in reusing the data.
Transform	Create new data from the original.
Occasional Actions	
Dispose	Delete data that were not selected for curation according to documented policies, guidelines and/or legal requirements. They can be destroyed or transferred to another location.
Reappraise	Return data that fail validation procedures for further appraisal and re-selection.
Migrate	Migrate data to a different format.

Source: adapted from Higgns (2008).

From the DCC Digital Curation Lifecycle Model and the elements and processes involved in digital preservation, we can observe that digital preservation is embedded in the entire digital curation process, as shown in Table 2.

Table 2: Relationship between digital preservation and digital curation

DCC Digital Curation	Digital Preservation	
	Elements	**Processes**
Information description and representation	Metadata, standards eauthenticity.	Treatment
Preservation planning	Institution's objectives, DPP, responsibilities, financial resources, technological infrastructure, laws and multidisciplinary team.	Identification of needs Organization Information monitoring
Community watch and participation	Organizational culture and responsibilities.	Use Information monitoring
Curate and preserve	Organizational culture, institution objectives, DPP, models, initiatives, copyright, administrative acts.	Information monitoring
Conceptualize	Models.	Identification of needs Storage
Create or receive	DPP, administrative acts, metadata, standards and support.	Identification of needs Treatment

DCC Digital Curation	Digital Preservation	
	Elements	**Processes**
Appraise and select	PPD, laws, copyright, selection and disposal.	Identification of needs Select and dispose
Ingest	Metadata, technological infrastructure, institutional repositories, support and standards.	Treatment Store
Preservation action	ICTs, standards and support.	Information monitoring
Store	Technological infrastructure, institutional repositories and support.	Store Development of products and services
Access, use and reuse	Technological infrastructure, institutional repositories and support.	Development of products and services Distribution and access Use
Transform	Digital preservation is not about data reuse. However, this action is related if this new data has to be treated and stored.	

DCC Digital Curation	Digital Preservation	
	Elements	Processes
Dispose	DPP, laws, copyright, select and dispose.	Identification of needs Select and dispose
Reappraise	Select and dispose	Select and dispose
Migrate	Metadata, authenticity, standards, preservation strategies and Support.	Storage Treatment Development of products and services.

Source: by the authors.

Table 2 shows that elements and processes related to digital preservation are included in digital curation actions, except for data reuse.

4 CONSIDERATIONS

Digital Curation similarly to Digital Preservation involves ensuring long-term access to digital objects, adding value to them. One of the characteristics of Digital Curation, which is discussed in Digital Preservation, is the concern with digital object reuse, especially digital data.

An area associated with Digital Curation to add value to digital objects is data analysis. A data analyst can contribute to the production of structured data and also to the appraisal of offered services and products.

In the same way as digital preservation, Digital Curation involves several areas and, in this sense, there is currently no specific training for a curator who understands all these areas. Thus, both Digital Curation and Digital Preservation must work on digital object management, constituting multidisciplinary teams and in constant exchange with other institutions, favoring contributions and expertise exchange.

In view of the above, it is evident that Digital Preservation is not only the application of preservation strategies on digital environments, as it is inserted in the entire life cycle of the digital object, encompassing technological changes and advances, organizational culture and organizational, legal elements and technicians. According to this conception, we have that Digital Preservation takes care of most of the actions recommended by Digital Curation.

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