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Case Study: NDSA Levels of Preservation

As the world and its inhabitants began to move away from analog forms of communication, work, and entertainment/media and become more digitally reliant, the need for digital preservation becomes more critical. Since much of digital-life spans are still unknown is up to institutions and individuals to proactive about ensuring the longevity of their digital assets. This is a solution that might sound simple, but without a baseline knowledge about rapidly changing technologies, preservation, and storage, the activities/steps necessary to properly preserve one's digital assets can be daunting and overwhelming. Thankfully, in 2003 the National Digital Stewardship Alliance [NDSA] published the NDSA Levels of Preservation [LoP], a matrix tired based set of guidelines that anyone [beginner to an expert] can use to guide them in the activities/steps that need to be implemented in order to preserve their digital content[1]. In honor of the NDSA release of the Levels of Preservation [version 2.0], this paper will offer an in-depth overview and history of the formation of the Levels of Preservation [version 1.0], the Levels revision history, the NDSA's reboot project, and the history of the National Digital Stewardship Alliance.

Organizational Overview & History

The National Digital Stewardship Alliance [NDSA] was a project born out of the National Digital Information Infrastructure and Preservation Program [NDIIPP], which was a government-funded program that had been stewerted by the Library of Congress [LOC][2] since

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[1] https://www.loc.gov/item/prn-10-178/library-of-congress-launches-digital-stewardship-alliance/2010-08-03/

[2] "Founded in 1800, the Library of Congress is the nation's oldest federal cultural institution.It seeks to spark imagination and creativity and to further human understanding and wisdom by providing access to knowledge through its magnificent collections, programs and exhibitions." https://www.loc.gov/about/history-of-the-library/

the year 2000. Sometime between the years 2000 and 2010, Congress ordered the LOC to join forces with other federal agencies and a diverse range of communities to develop a national approach to digital preservation. This new alliance was set to launch with founding members drawn from current NDIIPP project partners at the, who's first tasks were to develop a roadmap for the alliance and a process for expanding membership. It was also established during this time that the NDIIPP would provide administrative and membership management support during the Alliance's first four years of operation, starting from the point of launch forward[3][4].

On August 3rd, 2010, the Library of Congress announces the formation and launch of the National Digital Stewardship Alliance [NDSA]. The NDSA is originally introduced as a partnership of institutions and organizations dedicated to preserving and providing access to selected databases, web pages, video, audio, and other digital content with enduring value. In an official governmental blog post, the LOC and NDSA members listed the four main goals they had for the Alliance going forward: *1)* To develop improved preservation standards and practices for all digital content. *2)* To identify categories of digital information that most critical to preservation. *3)* Outline the steps needed to incorporate digital content into a national collection that would serve as a leading example and guide communities in digital preservation training and education. Lastly, *4)* Provide communication and outreach regarding all areas of digital preservation[5].

On December 15th and 16th, 2010, the NDSA held a two-day workshop in Washington, D.C, to discuss the mission, structure, function, and volunteer organization of the Alliance. Even though the NDSA launched in July, it was not until after this workshop took place, did the Alliance take a stance as leaders in the digital preservation field. Out of the 60 founding partner organizations, about 35 helped to plan and attend the workshop representing a wide range of

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[3] http://www.digitalpreservation.gov/ndsa/NDSAtoDLF.html

[4] https://www.loc.gov/item/prn-10-178/library-of-congress-launches-digital-stewardship-alliance/2010-08-03/

[5] https://www.loc.gov/item/prn-10-178/library-of-congress-launches-digital-stewardship-alliance/2010-08-03

communities such as government agencies, educational institutions, non-profit organizations, and commercial businesses. The main goal of the workshop was to have the participating members form group discussions focusing on what the core values of the NDSA should be, their mission, how new members will join, and how the Alliance will conduct business.[6][7]

By the end of the workshop, the participants were able to achieve their goals. The NDSA's now had a refined and vetted mission statement, which was "*To establish, maintain, and advance the capacity to preserve our nation's digital resources for the benefit of present and future generations*."[8]

The next thing established during the workshop was the organizational structure. It was decided that all regulatory activities, projects, and events will be executed via working and/or interest groups under the guidance of a coordinating committee. The NDSA defines interest groups as standing groups that provide information about areas of interest to the membership and may be formed as needed with approval from the coordinating committee. Working Groups are defined as groups formed with the primary goal of completing a task or project; they may be ongoing and scaled up or down as needed[9].

On January 1st, 2016, the National Digital Stewardship Alliance moved from under the Library of Congress's leadership, to under the Digital Library Federation (DLF)[10], which is under the Council on Library and Information Resources (CLIR). As of today, the NDSA has expanded greatly[11]. Despite originally being formed to help guide US-centric organizations and institutions, the NDSA has since gone international with currently over 250 organizations representing universities, government and non-profit organizations, commercial businesses, and professional associations worldwide[12].

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[6] http://www.digitalpreservation.gov//news/2011/20110105news_ndsaworkshop.html
[7] http://www.digitalpreservation.gov/ndsa/NDSAtoDLF.html
[8] https://blogs.loc.gov/thesignal/2013/12/the-ndsa-at-3-taking-stock-and-looking-ahead/
[9] https://ndsa.org/about/
[10] "The DLF is a combination of networked member institutions and a robust community of practice that focus on the following: advancing research, learning, social justice, and the public good through the creative design and wise application of digital library technologies." - https://www.diglib.org/about/
[11] https://www.diglib.org/about/
[12] https://ndsa.org/about/

Other Digital Preservation Guides/Models [Pre-NDSA Levels][13][14]

In the spring of 2012, when first deciding if the Levels of Preservation would be a worthy project, a few the NDSA members formed an interest group to research existing guides and models. In the end, the interest group felt that none of the guides or models offered specifically addressed the need for practical technical guidance for those just beginning to take the steps needed to preserve their digital assets or scale up the preservation activities need to ensure further longevity and access.

They felt that the majority of the existing models aimed more towards managerial and policy-based advice rather than technical and practical. The three models they focused on for their analysis and comparison are described below:

"*The Five Organizational Stages of Digital Preservation*" [2003] by Nancy McGovern and Anne Kenney. Their guide focused on the stages during an organization's development that needs to be reached for sustainable digital preservation. The guide emphasized organization policy rather than technology.

"*Digital Preservation Capability Maturity Model*" by Charles Dollar and Lori Ashley bases its guidelines from the Trustworthy Repositories Audit & Certification [TRAC] Criteria and Checklist[15]. While more technological driven, the model offered little to no practical application steps. The team ultimately felt that Dollar's and Ashley's model was also geared towards managerial or administrative level planning and design.

Lastly, the interest group researched "*You "ve Got to Walk Before You Can Run: First Steps for Managing Born-Digital Content Received on Physical Media*." which presented the Online Computer Library Center's [OCLC] model. While the OCLC's model was the closest resemblance to what the NDSA was hoping to achieve with their guide/model, and even end up

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[13] https://ndsa.org/activities/levels-of-digital-preservation/
[14] http://www.digitalpreservation.gov/documents/NDSA_Levels_Archiving_2013.pdf
[15] "TRAC, is the principle tool used by CRL in its auditing and certification of digital repositories. TRAC criteria measures the ability of a given repository to preserve digital content in a way that serves the repository's stakeholder community.TRAC metrics are based on the OAIS reference model/ ISO 14721:2012 standard." - https://www.crl.edu/archiving-preservation/digital-archives/metrics-assessing-and-certifying/trac

with some of the same recommendations, they ultimately felt the OCLC's scope was to narrow. The OCLC's model is only geared toward born-digital content on physical media.

Feeling dissatisfied with the current digital preservation guides and models available, the NDSA creates a working group with the goal of creating a guide of technical steps for digital preservation.

Levels of Preservation V.1

The Levels of Preservation project originated when members of the NDSA recognized the need for practical, technical, and scalable digital preservation guidance that was accessible both to those just getting started and those with fully implemented preservation programs looking to expand or upgrade. The NDSA believed they were the ideal organization to create and implement a digital preservation guide that would be beneficial to a wide range of individuals and institutions operating or just initiating a digital preservation plan because the alliance is made up of a diverse array of institutions: commercial, non-profit, cultural, small and large[16].

Prior to launch, the Levels NDSA working group informally surveyed NDSA members in order to identify desired goals and guiding principles for the Levels of Digital Preservation. Based on the survey results, the working group was able to decide on the primary goal of the Levels, which is to meet the need for more practical and accessible practices that are more substantial than an individual level of digital archiving, but less daunting and demanding than the certification requirements to become a trusted digital repository[17]. From there, they were able to create six core guiding principles to help guide them during the development of the Levels chart [18].

1) It must be useful for developing plans, but not be viewed as a plan in itself. It is to be viewed as a set of recommendations, not as a preservation strategy.
2) The levels are non-judgmental, meaning that it's important to keep in mind that organizations have different resources and priorities, and as a result, each one needs to allocate those resources best to meet their specific needs.

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[16] https://blogs.loc.gov/thesignal/2012/09/help-define-levels-for-digital-preservation-request-for-public-comments/
[17] http://www.digitalpreservation.gov/documents/NDSA_Levels_Archiving_2013.pdf
[18] https://blogs.loc.gov/thesignal/2012/09/help-define-levels-for-digital-preservation-request-for-public-comments/

3) Levels can be applied to collection(s) or system(s), the levels must be designed to function on a case by case basis, from collection level to a centralized archive.
4) The Levels must be designed to be content and system agnostic, meaning it's not content-specific. The levels must be general enough to apply to any digital preservation situation.
5) The structure of the chart is progressive -- the actions in the first level are either necessary prerequisites for those in the subsequent levels or are themselves the most important to implement. According to the NDSA, the intention in making these steps incremental is that they become increasingly more complex and require the work of the previous level to be possible.
6) The Levels would be a living document that will be adapted and improved driven by the designated user communities.

Based on the working group's six guiding principles, they decided that the design and organizational structure of the Levels would be a matrix structure that would feature multiple levels and content areas to allow flexibility so users could achieve different levels in different content areas according to their unique needs and resources. They also decided not to cover policy staffing or other organizational considerations; the recommended activities within the Levels would be agnostic towards both content type and technology, focused on specific technological preservation actions, not organizational requirements[19].

Lastly, the working group used the survey results to help determine that the LoP would be organized into five categories that they believe to be the most critical to digital preservation: *Storage & Geographic Location*; *File Fixity & Data Integrity*; *Information Security*; *Metadata*; *File Formats*. Even though the names for the five categories were agreed on early in the process, there were debates amongst the group on the titles for each of the levels: *Protect Your Data*; *Know Your Data*; *Monitor Your Data*; and *Repair Your Data*. Some members wanted to leave the labels out and organize the document according to the most significant risk to mitigate loss.

[19] http://www.digitalpreservation.gov/documents/NDSA_Levels_Archiving_2013.pdf

Other members thought that the level titles helped organize the grid and explain the general overarching goals of each level in a conceptual way. In the end, the level titles stayed.

Here is a more in-depth explanation of the Levels of Digital Preservation Guide V.1 five categories[20]:

Storage & Geographic Location: The first step one should take to ensure access to materials in the future would be to create a second copy. The first level recommends that one gets data that comes in on heterogeneous media (optical disks, external hard drives, etc.) off of the removable media and into a storage system. As one goes on to the higher levels, additional copies are being acquired, which helps defend against threats of loss due to bit rot and failures in storage media and systems. The last level [level 4] requires incorporating additional geographic locations to defend against environmental-based threats like natural disasters or human-generated damage to storage systems.

File Fixity & Data Integrity: The goal of this category is to provide a series of steps that will take an organization to a stage where it is actively ensuring the fixity of their digital content.
The first level recommends to check if prior fixity information is provided upon ingest [MD5 or SHA-1 cryptographic hashes], or to create a checksum if none were previously assigned. The requirements in Levels 3 and 4 shift from placing trust in the quality and performance of a particular storage media, to thinking of digital preservation as being ensured through the practice of active, repeated, and ongoing checking of content.

Information Security: The information security category focuses primarily on understanding who has access to content, who can perform what actions on that content, and enforcing these access restrictions.

Metadata: The NDSA Levels of Preservation working group defines metadata broadly to include everything from inventory information about the location of files, administrative metadata, transformative data, and logging events that have resulted in changes to the digital assets, to technical, descriptive, and preservation metadata. The NSDA also stresses that in most systems, nearly all of the metadata [except descriptive] can and should be generated and processed computationally, and not manually.

[20] http://www.digitalpreservation.gov/documents/NDSA_Levels_Archiving_2013.pdf

File Formats: The file formats category is the one that had the most revisions during the public review process. The first level recommends that organizations should encourage the use of limited sets of proprietary and open file formats. The subsequent levels recommend documentation of the formats in use, monitoring for obsolescence issues, and migrations, or support emulation if needed.

The National Digital Stewardship Alliance officially launches the Levels of Digital Preservation (LoP) guidelines in 2013 as a tiered set of recommendations on how organizations should begin to build or enhance their digital preservation activities[21].

Expanding the Levels of Preservation[22]

As I stated previously, one of the core principles of the Levels is that it would be a living document. The NDSA encouraged comments and suggestions for how to improve the document from the digital preservation and archive communities and users of the Levels. It is the intent of the NDSA and the LoP working group that revisions of the Levels will continue until they have garnered a broad consensus view of the progression of technical steps recommended for decreasing the risk to digital materials. They also have encouraged people to make changes to the document and expand or change things as they saw fit and to tag them in a blog post or email them detailing the reasoning and methodology behind the revisions made.

One of the most popular revisions was done by Shira Peltzman from UCLA Library. In April 2016, she expanded the NDSA Levels of Preservation so that the table includes a means of measuring an organization's progress with regard to access. Peltzman believed that if one is unable to provide access to the materials one is preserving, then they aren't doing a good job of preserving those materials in the first place. Peltzman had three main objectives when creating her version of the Levels: *1)*To acknowledge the OAIS reference model by referencing the creation of Dissemination Information Packages, which will, in turn, require users of the guide to take into account access-related terms like Designated Community, Representation Information and Preservation Description Information. *2)* Remain consistent with the model already in place. She

[21] https://ndsa.org/activities/levels-of-digital-preservation/
[22] https://blogs.loc.gov/thesignal/2016/04/expanding-ndsa-levels-of-preservation/

wanted to make sure that her additions to the chart remained agnostic to the recommended activities across categories and levels. *3)*To propose that her addition of the access category will eventually become officially incorporated into the next versioning of the NDSA Levels if and when it was released.

Access	Determine designated community[1] Ability to ensure the security of the material while it is being accessed. This may include physical security measures (e.g. someone staffing a reading room) and/or electronic measures (e.g. a locked-down viewing station, restrictions on downloading material, restricting access by IP address, etc.) Ability to identify and redact personally identifiable information (PII) and other sensitive material	Have publicly available catalogs, finding aids, inventories, or collection descriptions available to so that researchers can discover material Create Submission Information Packages (SIPs) and Archival Information Packages (AIPs) upon ingest[2]	Ability to generate Dissemination Information Packages (DIPs) on ingest[3] Store Representation Information and Preservation Description Information[4] Have a publicly available access policy	Ability to provide access to obsolete media via its native environment and/or emulation

Levels Reboot Project[2324]

In early 2018, some members of the NDSA and it's Coordinating Committee were made aware of several version updates made to the Levels of Preservation Guide in various ways by various people. The NDSA felt with all the community-based revisions, and the rapid changes in technology, a document that focuses on practical technological activities to achieve digital preservation, should be updated every five years. As a result, the National Digital Stewardship Alliance formed a new working group whose main goals would be to evaluate the current Levels of Preservation, expose and take into consideration the revisions done to the Levels by its users and individuals or institutions apart of the digital pre servation or archiving community, and to create a methodology by which the LoP could continue to be documented and reversioned over time.

[23] https://ndsa.org/working-groups/levels-of-preservation/#levels-reboot-team
[24] https://dpconline.org/blog/levels-of-preservation-reboot-overview-and-update

The new Levels working group was entitled *The Levels Reboot Projec*t. From their set primary goals, they were able to create six main objectives for creating LoP version 2.0: *1)* To identify those [individuals and institutions] that are actively engaging in adapting the Levels. *2)* To open the group up to a wide range of willing participants to get involved in updating the current version. *3)* Create an updated version of the Levels document. *4)* To create a methodology by which submitted revisions, suggestions/feedback, and approaches to digital preservation can be evaluated and incorporated into Levels version 2.0. *5)* Create other resources to support updated Levels documentation, such as case studies, user stories, and educational materials. *6)* Create guidelines by which the Levels can be adapted and revised on a regular basis by the public.

In order to achieve their primary goals and main objectives, the Levels Reboot working group sent out an initial call for interest and participation in April 2018. After the initial call, a survey was sent out asking for interest and user stories in February 2019. The LoP reboot team was then divided into six different subgroups: Each of these subgroups was assigned a main objective to focus on and meet on a regular basis. The groups have regularly been meeting since Spring 2018[25]:

Curatorial Layer Subgroup: This group was tasked with exploring the creation of a non-technical preservation decision layer that will allow curators and collection managers to make base-level preservation decisions that would directly correlate to the Levels.

Assessment Subgroup: This group explored the past and current uses, as well as any adaptations or revisions made to the Levels of Preservation organizational structure for institutional to tracking, managing, and assessment of their digital preservation readiness, or as a method to review progress towards an institution's overall preservation goals.

Documentation Subgroup: This subgroup explores the ways in which the Levels could be updated, commented on, distributed, critiqued, used, and implemented across diverse groups/sectors - nationally and internationally through a publicly accessible way. This group was also tasked with developing a process for reviewing the Levels to make sure it contains relevant and reliable information, and with developing a method for documenting versioning updates

[25] https://ndsa.org/working-groups/levels-of-preservation/#levels-reboot-team

made to the Levels. The last two tasks require them to work in partnership with the *Updating Levels Subgroup*.

Implementation Subgroup: The Implementation Subgroup focuses on the use and adaption of the Level's organizational structure in order to implement or improve digital preservation infrastructure, administration, and maintenance.

Levels of Preservation Revision Subgroup: This subgroups main charge is to update and add to the current Level categories. They often work with the *Documentation Subgroup* to ensure that the updates being made are being tracked/documented in an accessible and transparent way.

Teaching, Outreach, and Advocacy Subgroup: The last group focuses on the use and adaption of the Levels of preservation as a tool for teaching the concepts and practical applications of digital preservation, and to advocate for preservation resources.

Levels of Preservation V2.0[26][27]

On October 16th, 2019, the Levels reboot working group officially released the NDSA Levels of Preservation Version 2.0. The most notable difference is that the previous versions categories [storage and geographic location, file fixity and data integrity, information security, metadata, and file formats] have been changed to simply Storage, Integrity, Control, Metadata, and Content. The two most significant name changes are Information Security to Control, and File Formats to the broader term Content. This change aligns with the NDSA mission to make the Levels as flexible and adaptable as possible, moving away from any form of specifics towards broader, almost "catch-all" terminology. The working group wanted the Levels to feature actions independent of specific formats, content types, and storage systems.

A noticeable snub from this revision is that the Levels Reboot group decided not officially to incorporate access as a category. Peltzman's expanded Levels chart was one that many in the digital preservation and archiving community verbally supported and used. During the 2019 Association of Moving Image Conference [AMIA], the head members of the Levels Reboot working group held a panel to introduce the LoP version 2.0 to the archiving community formally. During this panel, many attendees questioned the members on their decision not to

[26] https://ndsa.org/activities/levels-of-digital-preservation/
[27] https://ndsa.org/working-groups/levels-of-preservation/#levels-reboot-team

include access as an official category; their response stated that because the NDSA is dedicated to creating tools and resources for a wide range and diverse set of institutions, organizations, and individuals worldwide, they had to take into account that not everyone's goal will be access. For example, personal or corporate based archives are usually private, and therefore, there is no need to make their collections accessible.

The last significant change the reboot team made to the Levels was that they realigned the levels so that they have a stronger progressive implication, and that each level naturally builds upon the prior one to guide a repository into greater maturity.

Final Thoughts

After researching the NDSA and the origins of the Levels of Preservation, it is my belief that the primary goals and purposes of the LoP were unclear to many in the digital preservation community. For example, I and a few others looked to the Levels as more of a preservation plan to be implemented, rather than as a set of recommendations individuals and institutions could modify. I appreciated the broadness of the revisions to make digital preservation more inclusive, especially when, as we learned in class, other digital preservation standards require high levels of funding, resources, and prior field knowledge, making it hard for many smaller and nonprofit institutions to gain access.

Going forward, I suggest that for future versions, the NDSA reaches out to more scholars of digital preservation, archiving, and management. I don't believe the reboot team's "call for action" was advertised very well. As more research is being allocated towards digital life-spans, software, and storage, the core needs of the digital preservation community will begin to change. Thus, in the future, I see the NDSA Levels steps and categories expanding in an official capacity, perhaps from five core categories to seven or 8.

Appendix I

Table 1: Version 1 of the Levels of Digital Preservation

	Level 1 (Protect your data)	Level 2 (Know your data)	Level 3 (Monitor your data)	Level 4 (Repair your data)
Storage and Geographic Location	- Two complete copies that are not collocated - For data on heterogeneous media (optical discs, hard drives, etc.) get the content off the medium and into your storage system	- At least three complete copies - At least one copy in a different geographic location - Document your storage system(s) and storage media and what you need to use them	- At least one copy in a geographic location with a different disaster threat - Obsolescence monitoring process for your storage system(s) and media	- At least three copies in geographic locations with different disaster threats - Have a comprehensive plan in place that will keep files and metadata on currently accessible media or systems
File Fixity and Data Integrity	- Check file fixity on ingest if it has been provided with the content - Create fixity info if it wasn't provided with the content	- Check fixity on all ingests - Use write-blockers when working with original media - Virus-check high risk content	- Check fixity of content at fixed intervals - Maintain logs of fixity info; supply audit on demand - Ability to detect corrupt data - Virus-check all content	- Check fixity of all content in response to specific events or activities - Ability to replace/repair corrupted data - Ensure no one person has write access to all copies
Information Security	- Identify who has read, write, move and delete authorization to individual files - Restrict who has those authorizations to individual files	- Document access restrictions for content	- Maintain logs of who performed what actions on files, including deletions and preservation actions	- Perform audit of logs
Metadata	- Inventory of content and its storage location - Ensure backup and non-collocation of inventory	- Store administrative metadata - Store transformative metadata and log events	- Store standard technical and descriptive metadata	- Store standard preservation metadata
File Formats	- When you can give input into the creation of digital files encourage use of a limited set of known open formats and codecs	- Inventory of file formats in use	- Monitor file format obsolescence issues	- Perform format migrations, emulation and similar activities as needed

Appendix II

Functional Area	Level			
	Level 1 (Know your content)	**Level 2 (Protect your content)**	**Level 3 (Monitor your content)**	**Level 4 (Sustain your content)**
Storage	Have two complete copies in separate locations Document all storage media where content is stored Put content into stable storage	Have three complete copies with at least one copy in a separate geographic location Document storage and storage media indicating the resources and dependencies they require to function	Have at least one copy in a geographic location with a different disaster threat than the other copies Have at least one copy on a different storage media type Track the obsolescence of storage and media	Have at least three copies in geographic locations, each with a different disaster threat Maximize storage diversification to avoid single points of failure Have a plan and execute actions to address obsolescence of storage hardware, software, and media
Integrity	Verify integrity information if it has been provided with the content Generate integrity information if not provided with the content Virus check all content; isolate content for quarantine as needed	Verify integrity information when moving or copying content Use write-blockers when working with original media Back up integrity information and store copy in a separate location from the content	Verify integrity information of content at fixed intervals Document integrity information verification processes and outcomes Perform audit of integrity information on demand	Verify integrity information in response to specific events or activities Replace or repair corrupted content as necessary
Control	Determine the human and software agents that should be authorized to read, write, move, and delete content	Document the human and software agents authorized to read, write, move, and delete content and apply these	Maintain logs and identify the human and software agents that performed actions on content	Perform periodic review of actions/access logs
Metadata	Create inventory of content, also documenting current storage locations Backup inventory and store at least one copy separately from content	Store enough metadata to know what the content is (this might include some combination of administrative, technical, descriptive, preservation, and structural)	Determine what metadata standards to apply Find and fill gaps in your metadata to meet those standards	Record preservation actions associated with content and when those actions occur Implement metadata standards chosen
Content	Document file formats and other essential content characteristics including how and when these were identified	Verify file formats and other essential content characteristics Build relationships with content creators to encourage sustainable file choices	Monitor for obsolescence, and changes in technologies on which content is dependent	Perform migrations, normalizations, emulation, and similar activities that ensure content can be accessed

Levels of Digital Preservation v2.0 September 26, 2019

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