Building the Business Case for Digital Preservation
Using the Digital Preservation Capability Maturity Model

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Introduction

The *Final Report of the Blue Ribbon Task Force on Sustainable Digital Preservation and Access*[1] (2010) recommends that the digital preservation community develop an economic model that incorporates a digital preservation value proposition. Implicit in a digital preservation value proposition is the concept of making a compelling business case for digital preservation to resource allocators, policy makers, and other stakeholders. In this paper[2] we introduce the use of the Digital Preservation Capability Maturity Model© (DPCMM)[3] to support a generic business case methodology adapted to digital preservation. The components of this methodology include a clearly defined goal or purpose, a requirements analysis, current state and desired future state analysis using measurable performance metrics, strategy, and recommendations for an incremental improvement roadmap. We conclude this paper with a summary of an International Council of Archives (ICA) initiative to adapt the DPCMM to mobile technology.

What is a Capability Maturity Model?

In 1990 the Software Engineering Institute of Carnegie Mellon University developed a Capability Maturity Model4 to enable organizations to assess the maturity of their software development processes and identify key practices necessary to improve the capability of those processes. The CMM defines five progressive stages of process maturity[5] based on an organization's support for certain key software development areas. Each stage includes a series of associated activities and baseline metrics used to measure performance. These maturity stages are cumulative: an organization achieving a higher stage of maturity must implement and sustain all of the requirements for that stage in addition to requirements for all of the lower stages.

Why A Digital Preservation Capability Maturity Model?

The Open Archival Information System (OAIS) Reference Model (ISO 14721:2012) identifies high level services and requirements that a preservation repository should provide to support

long-term access. An additional standard (i.e., ISO 16363:2012) specifies auditing criteria for the

certification of trustworthy repositories. The OAIS defines digital preservation services and associated activities at a very high level so they must be deconstructed into terms that are readily understood and can be applied in operational preservation environments. The audit criteria certification checklist of ISO 16363 includes more than one hundred requirements. Neither standard identifies explicit performance metrics to assess the current digital preservation capabilities of preservation repositories or information systems. Nor do they explicitly support an incremental digital preservation capability improvement plan.

Stages of Digital Preservation Capability Maturity

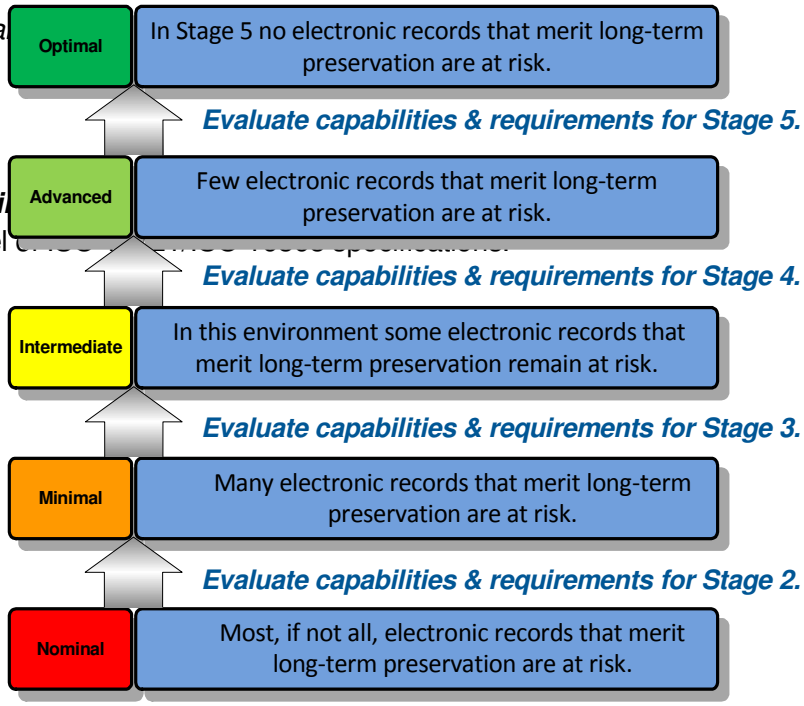
The Digital Preservation Capability Maturity Model[6] has five levels (see Figure 1) that track closely with the five stages of the CMM discussed earlier, albeit with a specific digital preservation emphasis.

Nominal Digital Preservation Capability: A systematic digital preservation program has not been undertaken and *most, if not a*

are at risk.

Minimal Digital Preservation Capabi
rudimentary and do not rise to the level

Consequently, most electronic records



Intermediate Digital Preservation Capability: The organization supports initiatives and projects that approach but do not conform fully to ISO 14721/ISO 16363 specifications. There is an established basis for proactive and sustainable digital preservation improvement actions over time. *Nevertheless, it is likely that some electronic records that merit long term retention remain at risk.*

Figure 1. Stages of Digital Preservation Capability Maturity

Advanced Digital Preservation Capability: The organization has a robust infrastructure and the preservation of electronic records is undertaken with a governance and operational framework that conforms to most of the ISO 14721 specifications and the criteria of ISO 16363. *Few electronic records that merit long-term preservation are at risk.*

Optimal Digital Preservation Capability: The organization maintains a strategic focus on digital preservation outcomes by continuously improving the manner in which electronic records lifecycle management is executed. Optimal digital preservation

capability also involves benchmarking infrastructure and services relative to other “best in class” digital preservation programs and conducting proactive monitoring for breakthrough technologies that can enable the program to improve its digital preservation performance. *Few if any electronic records that merit long-term preservation are at risk.*

Digital Preservation Capability Maturity Model Components

As noted earlier, the components of the DPCMM are an amalgamation of key specifications, requirements, and activities abstracted from ISO 14721 and 16363 standards and digital preservation "best practices." The model includes two major stakeholder groups – Records Producers (or donors) and Users who seek access to the contents of the digital preservation repository. Figure 2 displays the three domains of DPCMM and associated components.

Digital Preservation Infrastructure Analysis: DPCMM features seven (7) components that are essential to ensuring sustained organizational commitment including, human, technical and

financial resources, to the long-term preservation of electronic records that are created, received

or acquired by the organization. The infrastructure components are:

- Digital Preservation Policy
- Digital Preservation Strategy
- Governance
- Collaboration
- Technical Expertise
- Open Standard Technology Neutral ("OS/TN") Formats
- Designated Community

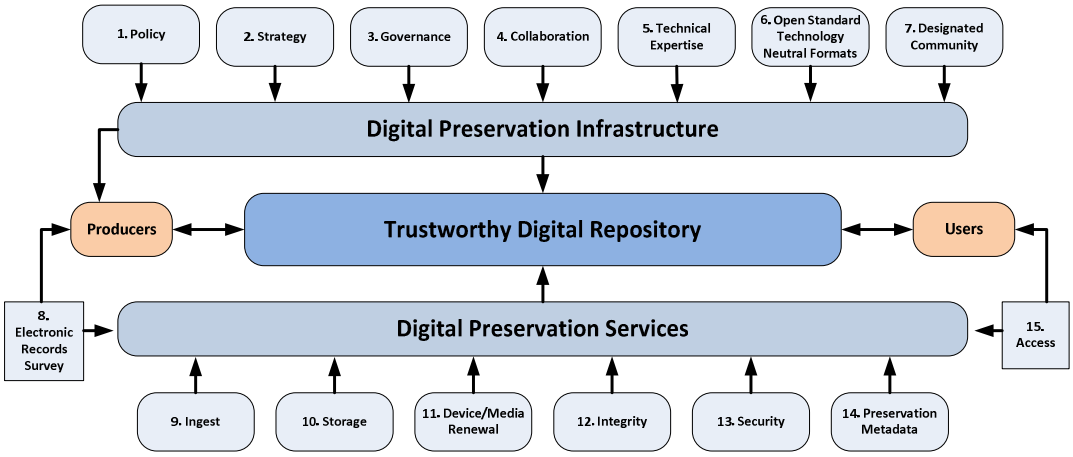


Figure 2. Digital Preservation Capability Maturity Model (DPCMM)

Digital Preservation Services Analysis: DPCMM specifies eight (8) components that are required for continuous monitoring of external and internal environments to plan and take necessary preservation actions that sustain the integrity, security, usability and accessibility of electronic records stored in repositories. The Digital Preservation Services are:

- Electronic Records Survey
- Ingest
- Archival Storage

- Media/Device Renewal
- Integrity
- Security
- Preservation Metadata
- Access

The DPCMM describes the scope and focus of each of the fifteen components and their performance metrics. An example of one of the components is the Electronic Records Survey, which is a critical interface between Records Producers, the Repository, and the Digital Preservation Services domain.

An Electronic Records Survey addresses the need for an informed estimate of the volume, file formats, and types (e.g., images, text, and databases) of digital content that will be transferred to the repository or safeguarded by record producers in their own operational and technology environments. Practitioners are encouraged to engage records producers to capture

preservation-ready[7] electronic records at or near the time of their creation or receipt. Below is

the DPCMM description of the Electronic Records Survey component.

DPCMM COMPONENT 8: Electronic Records Survey

Each organization is responsible for records created, received or acquired that are evidence of its business activities, regardless of the format or media used. The records' authenticity, integrity, usability and reliability must be ensured for as long as they are required. Records with long-term retention requirements or archival (permanent) value are often transferred to the custody of a centralized Records Management and/or Archives function for preservation.

Due to the fragility of electronic records, organizations are advised to proactively address digital preservation as close to the time of electronic records creation or capture as practicable. This can only be accomplished if the organization has a comprehensive inventory of electronic records as well as collaborative working relationships and agreements between stakeholders that include Records Producers, Legal/Compliance, Archives, Records Management, Information Technology/Services as well as third party application, solution and service providers.

A key feature of a conforming ISO 14721 open archival information system is the reliance on open standard interoperable technology neutral formats. During Ingest electronic records in proprietary formats must be transformed into formats that the organization and/or repository have adopted. Over time and with increasing volumes of electronic records, format transformation during the Ingest process may become burdensome. This obligation can be mitigated in part if "preservation-ready" records, that is, records that are in open standard interoperable technology neutral formats, are made at or near the time Records Producers create or capture the records.

The objective of an Electronic Records Survey is to identify three broad categories of records in order to support planning and preservation activities: "**Preservation-Ready**" electronic records; "**Near Preservation-Ready**" records, that is electronic records in formats for which tools are available that can export native format documents to open standard interoperable technology neutral formats. "**Legacy**" records, that is, electronic records in a proprietary native format for which no export or viewer technology tools exist. Transformation of proprietary native formats into open standard, interoperable, and technology neutral formats is likely to require writing code to support this transformation, which in turn is likely to be costly.

The collection and analysis of data for an Electronic Records Survey can be accomplished by a variety of means: web enabled surveys of record producing units and service providers, interviews with selected business units or third parties that routinely create, receive or acquire electronic records, review of the organization's records retention and disposition schedules, analysis of the organization's information technology portfolio and strategic plan, as well as the use of "crawler" functionality to identify specific file formats currently used in the capture and storage of electronic records on network drives.

Digital Preservation Capability Performance Metrics

The five incremental maturity levels described previously comprise performance metrics for each component of the Digital Preservation Capability Maturity Model. The performance metrics of each component constitute a checklist that is used to conduct a self-assessment of an organization's current digital preservation capability vis-a-vis that of an optimal capability. They also serve to raise awareness and educate stakeholders about current and evolving operational digital preservation practices, technology solutions, and standards. Performance metrics for the Electronic Records Survey Component are provided below.

Level	Electronic Records Survey Capability Metrics
0	The organization has little or no capability or resources to collect and analyze information about the volume, location, media, format types, and life cycle management requirements for electronic records.
1	The organization uses existing retention schedules to identify electronic records of permanent historical, fiscal, and legal value in the custody of Records Producers. It may also conduct ad hoc, one-time interviews and surveys to identify other electronic records of permanent historical, fiscal, and legal value.
2	The organization uses systematic interviews, surveys, and retrospective analysis of existing retention schedules to identify electronic records of permanent historical, fiscal, and legal value in the custody of select Records Producers. This effort may be enhanced by focusing on identified "at risk" electronic records.
	ISO 14721 Conformance
3	The organization supplements analysis of "at risk" electronic records through collection of information about the volume and location, media and format types (preservation ready and near-preservation ready) of permanent electronic records in the custody of Records Producers.
4	The organization has identified and categorized all preservation ready, near-preservation ready, and legacy permanent electronic records in the custody of all Records Producers.

Figure 3. Performance Metrics for Electronic Records Survey

Digital Preservation Surrogates and Essential Properties

ISO 14721 and ISO 16363 are "gold standards" for digital preservation. While many organizations will strive to implement and sustain a conforming ISO 14721/16363 digital preservation environment, the reality is that some organizations cannot or may choose not to implement a traditional standalone repository. Reliance on routine operational environments for long-term storage is the usual alternative to a standalone repository. Other organizations may

lack a sufficiently mature information infrastructure and architecture and/or have such limited technical and financial resources, that in the short run they are not in a position to implement a conforming ISO 14721/ISO 16363 digital preservation repository.

The DPCMM takes into account this spectrum of digital preservation activities by distinguishing between ISO 14721 conforming and partially-conforming capabilities and services through the use of two concepts: 1) surrogates and 2) "essential properties" of SIPs, AIPs, and DIPs. DPCMM defines surrogates as a range of services, tools, projects and initiatives currently used to address digital preservation requirements that are substantive and represent evolving/emerging capabilities.

Although they do not conform to intermediate (Level 3) or advanced (Level 4) metrics for a given component they may meet threshold requirements for the lower level performance metrics. "Essential Properties" identify minimum metadata attributes that support fully conforming ISO 14721 Submission Information Packages, Archival Information Packages, and Dissemination Information Packages.[8]

Digital Preservation Capability Assessment

Each of the 75 capability statements in the Digital Preservation Capability Maturity Model has an integer value ranging from 0 to 4. Using the previously described Electronic Records Survey component as an example, an organization that relies solely on its record retention schedules to identify long-term and permanent records to be transferred to a preservation repository would yield a score of "1." This score becomes the **index value** for the organization's current Electronic Records Survey capability.

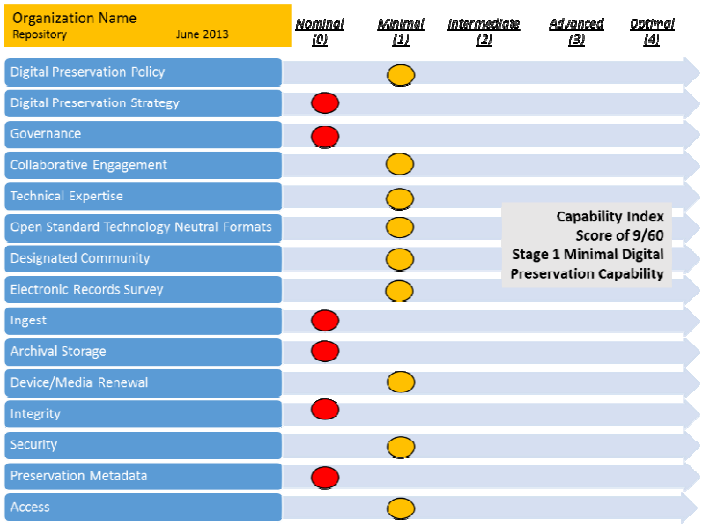


Figure 4. Digital Preservation Capability Index Score

Performing this assessment for all of the 15 components of the DPCMM produces a Digital Preservation Index score for each component as well as an Aggregated Digital Preservation Capability Index Score that is mapped to the appropriate level of digital preservation capability. Note that in Figure 4 six of the components had a 0 score and nine had a score of 1. A score of 9 denotes that most if not all of the electronic records that merit long term preservation are at risk.

Building the Business Case for Digital Preservation

Increasingly many public and private organizations recognize that systematic management of their digital assets requires implementation of a program that can assure access to authentic records of long-term value. But competing for the attention of senior management and for the financial and technical resources that will be needed to ensure digital continuity of electronic records is a significant challenge.

Mission, Vision, Values and Guiding Principles

An organization's mission, vision, values and guiding principles should drive the requirements and duty to preserve electronic records and other digital information assets. The opening sections of a digital preservation business case should focus on issues and risks that are compelling to the audience. Key business drivers (compliance, risk mitigation, cost reduction, institutional memory, etc.) associated with lifecycle management of digital information and assets should be identified early in the document and leveraged throughout the business case to build a robust action plan.

Regulatory, Legal, Operational and Cultural Memory Environments

An "informed" scan of the regulatory, legal, operational, and cultural memory environment that identifies laws and regulations, standards, best practices, and benchmarks that bear upon long-term access to and protection of electronic records is an essential component of a Business Case for Digital Preservation. Requirements for this domain are available on various public sector and industry association websites. A robust set of resources in the form of national and international standards, specifications, protocols, and tools also have emerged and should be factored into digital continuity planning exercises and repository service level agreements.

Information Technology Systems, Platforms and File Formats

A business case for digital preservation also requires a working knowledge of the current and planned information technology systems and platforms as well as the file formats used to create and store electronic records (e.g., Electronic Records Survey). This includes an understanding of the functionality of core business applications and document and content management systems that may be required to transfer digital content from an operational environment to a trustworthy digital preservation repository. Decision makers will need to understand which systems and types of records are most likely to be impacted by technology obsolescence to help them focus attention on "at risk" information assets and move forward with the implementation of mitigation strategies and initiatives.

Strategy and Tactics

Based on each organization's specific goals and objectives, a strategy to achieve the desired future state of digital preservation capabilities and lifecycle control of its information assets can be developed that take into account both the external and internal requirements and operating environments. This is likely to require dialogue among stakeholders about what constitutes digital preservation that is "good enough" to fulfill the organization's mission and meet the expectations of its stakeholders within its constrained resources.

Governance and Accountability

A clear delineation of the roles and responsibilities across the chain of electronic records management for record producers, system administrators, and repository custodians is a

fundamental component of a sustainable organization-wide information governance. Identification of the roles and responsibilities of current and future internal and external stakeholders is an essential part of a business case for digital preservation.

Return on Investment

A digital preservation business case should identify a Return on Investment (ROI) in the preservation of information assets over an extended period of time. Typically, this can be defined as Cost Avoidance in mitigating future technology obsolescence, which is the major impediment to access to electronic records as far into the future as required. In this context it is likely that few preservation repositories will ever fully conform to the specifications of ISO 14721. Nonetheless, the planning and justification for the financial and technical resources required for preserving and enabling future access to electronic records over time and technology platforms will provide resource allocators with a stronger sense of the digital preservation value proposition.

Incremental Digital Preservation Capability Improvement Road Map

Organizations can use the results of a Digital Preservation Capability self-assessment to develop a roadmap for incremental capability improvement as well as measure their status against peer organizations. The improvement roadmap should take into account both available resources and on-going strategic and tactical business initiatives.

An important consideration in designing an incremental digital preservation plan that is suited to the organization's mission and designated communities of stakeholders is to mitigate near-term risk exposure for as many of the components as is feasible. It is likely that constrained resources will require the prioritization of some components where significant improvement may be achieved while other components by default may undergo little improvement for the foreseeable future.

Figure 5 displays a "real world" year digital preservation infrastructure improvement plan that maps to the capability results shown in Figure 4. There are two (2) aspects of this improvement plan that should be highlighted. First, at the end of four (4) years each digital preservation infrastructure capability score has increased to 3, which represents Advanced digital preservation capability. Currently, the organization's resources do not support moving beyond this level.

DPCMM Components	Current Capability	Year 1	Year 2	Year 3	Year 4	Year 5	Difficulty
INFRASTRUCTURE							
Policy	1	2	⇨	⇨	3	⇨	LOW
Strategy	0	2	⇨	⇨	3	⇨	MEDIUM
Governance	0	1	2	3	⇨	⇨	MEDIUM
Collaboration	1	2	⇨	3	⇨	⇨	MEDIUM
Technical Expertise	1	⇨	⇨	2	⇨	3	MEDIUM
Open Standard Technology Neutral File Formats	1	⇨	2	⇨	3	⇨	MEDIUM
Designated Community	1	⇨	2	⇨	3	⇨	MEDIUM

Figure 5. Digital Preservation Capability Improvement Road Map

Second, the organization established priorities on when to begin and to complete each infrastructure component. For example, Governance begins with a 0 score and by the end of year 3 it will achieve a level 3 capability score. In contrast, Technical Expertise begins at level 1 and will achieve level 2 by the end of year 3 and level 3 by the end of year 5. The “Difficulty” column indicates an assessment of the level of effort that may be required to reach level 3 capability.

Mobile Archives Standardization Tool

In 2012 Milovan Misic, the newly elected President of the ICA Section of International Organizations (SIO), initiated development of a multi-year work plan to advance records and archives management among the section members. Members of the section had an on-going interest in digital preservation issues so Charles Dollar and Lori Ashley were invited to provide a workshop on the Digital Preservation Capability Maturity Model and its potential use at the 39th Annual Meeting of the SIO held in Brussels, Belgium in June 2013. In attendance was the Chief Inspector of the Joint Inspection Unit (JUI) who was in the final stages of completing his review and analysis of records and archives management in the United Nations. The report[9] identified the growing worldwide concern regarding the continuity of digital information and expressed appreciation for the technical considerations, especially those associated with DPCMM, shared during the workshop. The fourth of the six recommendations contained in the report references the importance of capturing, creating and managing e-records in ways that meet international standards for recordkeeping and the preservation of digital records and archives.

The SIO work plan included a proposal for the development of mobile technology that could promote and make accessible international standards and training materials to ICA members. In 2013 the International Council on Archives agreed to fund a proof of concept for a mobile application tool designed to support practitioners in the lifecycle management of records and archives.

The Mobile Archives Standardization Tool (MAST)© was conceived as a practical tool for records management and archives practitioners who are working in low resource environments, such as Africa, Caribbean and South America. Low resource mean low availability of electrical service, low connectivity, and limited professional records and archives management expertise. Use of mobile technology, combined with additional functionalities, is intended to directly support implementation of e-government administrative reforms, access to information, and adequate management and preservation of digital records.

Development of the MAST application was iterative and the version currently under evaluation includes a high level self-assessment based on the Digital Preservation Capability Maturity Model, international standards, and training curriculum. The first release of the curriculum is scheduled to include two ICA modules on Digital Preservation and Managing Metadata.

MAST is currently available on Android and Apple platforms, making it suitable for most commonly used mobile devices. It is being piloted as part of training for United Nations regional agencies in Africa in September 2014 with plans to expand its use in other regions.

Providing a digital preservation self-assessment component via a mobile application is intended to help practitioners to baseline their programs and consolidate their improvement efforts. MAST modules and links to ICA and other resources can directly support capacity building for records and archive management programs and move them towards full compliance with internationally recognized standards.

End Notes

[1] Available at http://brtf.sdsc.edu/biblio/BRTF_Final_Report.pdf.
[2] This paper is published in conjunction with an oral presentation that Charles Dollar, Lori Ashley, and Milovan Misic will deliver at the 2nd ICA Annual Conference in Girona (Spain), October 15, 2014.
[3] The genesis of the Digital Preservation Capability Maturity Model (DPCMM) is rooted in a presentation given to the Arizona Electronic Records Management Task Force in 2002. Some aspects of DPCMM subsequently were inspired in part by material developed by the International Records Management Trust to support assessment of the readiness of an organization to undertake an electronic records management program. For a related capability model approach see Christopher Becker, et al, "Assessing Digital Preservation Capabilities Using a Checklist Assessment Method," iPRES 2012, October 1 - 5, Toronto, Canada. Available at https://ipres.ischool.utoronto.ca.
[4] In 2002 the Software Engineering Institute replaced CMM with a new product, Capability Maturity Model Integrated (CMMI), and discontinued support of CMM. CMMI is a robust but generic business process improvement model.
[5] A good source for a description of the CMM is Mark C. Paulk, et al, "The Capability Maturity Model: A Summary," which can be accessed through the Carnegie Mello Research Showcase at http://repository.cmu.edu.
[6] See Digital Preservation Capability Maturity Model Ver 2.6 (2014). Available at www.securelyrooted.com/dpcmm.
[7] "Preservation ready records" references electronic records that were initially created or captured in a repository approved open standard technology neutral format.
[8] See Appendix B of Digital Preservation Capability Maturity Model Ver 2.6 available at www.securely rooted.com/dpcmm.
[9] See Records and archives management in the United Nations (JU/REP/2013/2) available at https://www.unjiu.org/en/reports-notes/JIU%20Products/JIU_REP_2013_2_English.pdf.