Reflections on trends in the identification and preservation of digital records, 1963 – 2013

Introductory remarks delivered by Charles M. Dollar where he and Lori Ashley facilitated a Digital Preservation Capability Maturity Model Workshop, International Council on Archives 39th Annual Meeting of the Section of International Organizations (SIO)
12 June 2013 - Brussels, Belgium.

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Key words: digital preservation, Digital Preservation Capability Maturity Model (DPCMM), information governance, ISO 14721, Machine-Readable Records, Technology Neutral Formats, technology obsolescence

1. Introduction - a bit of personal history

I am delighted to join my colleague, Lori Ashley, in conducting this workshop on the Digital Preservation Capability Maturity Model. Lori suggested that we begin the workshop with my sharing several observations about trends in electronic records management and digital preservation over the past forty years or so. I can best do this within the context of a personal history that involves several streams of thought and activity in the evolution of the management and preservation of electronic records.

In 1963 I completed a M. A. thesis in American History at the University of Kentucky entitled "Southern Senators and the Senate Farm Bloc, 1921 – 1925." The thesis analyzed voting patterns in the U. S. Senate using a cluster analysis methodology political scientists had reformulated to study voting patterns in legislative bodies and judicial tribunals. I reviewed more than 200 relevant roll call votes, captured the voting outcomes on IBM punch cards, and generated statistical correlations of voting patterns using a tabulating punch card machine (this was very primitive). Three years later I completed a Ph.D. dissertation on "Southern Senators and the Senate Progressive Movement, 1921 – 1933," which involved an analysis of more than 1200 roll call votes. By this time the University of Kentucky had upgraded its computer resources so now I stored the roll call votes on magnetic tape and used a real computer (IBM 7040) to generate more powerful voting pattern correlations.

In 1966 I joined the History Faculty at Oklahoma State University where I continued my computer-based historical research Two years later , I was invited to give a paper on "Documentation of Machine -Readable Records and Research: A Historian's Perspective"[1] at a conference that attracted the interest of Bert Rhoads, Archivist of the United States. His interest, I think, was based in part of on my comparison of the deciphering of the Rosetta Stone, with the need for the preservation of documentation of ADP (Automated Data Processing) records. Deciphering the Rosetta Stone in the 1830s had enabled scholars of Egyptian history to read Egyptian hieroglyphics and

[1] This paper was later published as Dollar, C. M. (1971), "Documentation of Machine-Readable Records and Research: A Historians View", *Prologue,* Vol. 3 No. 1, pp. 27-31..

recover a portion of Egyptian history unknown to them at the time. Incidentally, I think this is the first published reference linking the preservation of machine-readable records to deciphering the Rosetta Stone. In 1972 Richard Jensen and I co-authored Historian's Guide to Statistics: Quantitative Ana*lysis and Historical Research,*[2] which was an introduction to the use of statistics and computers in historical research.

During these years Bert Rhoads and I communicated periodically about efforts of the United States National Archives to develop a Machine-Readable Archives Program. In 1974 I accepted an invitation to become the Director of a newly established Machine-Readable Archives Division. I served in this capacity for six years and then I helped create a small staff that reported to the Archivist of the United States on the impact of information technologies on the creation, acquisition, and preservation of federal agency electronic records of permanent value. I remained in this position until 1994 when I joined the Faculty of the School of Library and Archives Information Studies at the University of British Columbia[3] where I developed and taught new courses that involved records and information technologies in a revised Master of Archival Studies Curriculum.

Since leaving the University of British Columbia in 1999 much of my work has focused on information technology standards and the preservation of trustworthy and usable digital records. I was a member of the U.S. delegation of the International Standards Organization Technical Committee 171[4]. I was the subject matter expert and primary author of the International Standard Organization TR 18492: 2005 "Long- term preservation of electronic document-based information"[5], and Chair of the Association of Image and Information Management Standards Board. I was a Senior Consultant with Cohasset Associates between 1999 and 2010. In 2011 I became an independent consultant and shortly thereafter began collaborating with Lori in several records management and digital preservation projects and development of the Digital Preservation Capability Maturity Model©, which is the focus of this workshop.

My involvement with the International Council of Archives began in 1980 when I gave a major paper on "Quantitative History and Archives" at the London conference.[6] Four years later I became the representative of the National Archives of the United States

[2] Dollar, C. M. and Jensen, R. (1971), *Historian's Guide to Statistics: Quantitative Analysis and Historical Research,* Rinehart and Winston, New York.

[3] iSchoo@UBC: School of Library Archival and Information Studies [University of British Columbia]. (2016), "Home page", Vancouver: School of Library, Archival and Information Studies [University of British Columbia],, available at: http://www.slais.ubc.ca/ (accessed 15th January 2016).

[4] International Standards Organization. (2016), "ISO/TC 171 Document Management Applications", Geneva: International Standards Organization, available at: http://www.iso.org/iso/standards_development/technical_committees/other_bodies/iso_technical_committee.htm?commid=53650 (accessed 15th January 2016).

[5] International Standards Organization (2005b), "ISO/TR 18492:2005 Document Management -- Long-term Preservation of Electronic Document-based Information ", Geneva, International Standards Organization.

[6] Dollar, C. M. (1980), "Quantitative History and Archives", paper presented at the IXth International Council on Archives, London.

on the ICA Committee on ADP Records and continued in this capacity until 1996, serving as Chair from 1990 - 1996. Meanwhile, in 1985 Gertrude Long of the International Monetary Fund and Chair of the ICA Section of Archivists of International Organizations invited me to conduct a UNESCO funded study of electronic records management in International Organizations. I presented the findings and recommendations of this study to the SIO at its annual meeting in September 1985. In 1986 UNESCO published the study, "Electronic Records Management in United Nations Organizations"[7] that was widely disseminated within UN organizations and gave rise to a UN Technical Panel on Electronic Records Management (TP/REM) that contracted with consultant David Bearman to prepare a report entitled *Management of Electronic Records: Issues and Guidelines (*1990), which is still relevant for UN organizations. Later, I was an electronic records management consultant for the European Reconstruction and Development Bank, the World Bank, the Asian Development Bank, the Food and Agriculture Organization, and the World Intellectual Property Organization, among others.

In 1992 the University of Macerata, Italy published my book, *Archival Theory and Information Technologies: The Impact of Information Technologies on Archival Principles and Methods*, in which I explored relationships between the principles of archival science and information technologies.[8] Seven years later, Cohasset Associates published, *Authentic Electronic Records: Strategies for Long-Term Access*, which in 2000 received the Society of American Archivists prestigious Wald Gifford Leland Award for "superior excellence and usefulness in the field of archival history, theory or practice."

This brings me full circle to the 2013 Annual Meeting of the International Council on Archives Section of International Organizations. I want to begin by delineating a high level historical context for this Workshop on the Digital Preservation Capability Maturity Model. This context consists largely of my reflections on how the archives and records management professions have adapted to enormous changes in information technologies over the past four decades.[9] These reflections are rooted in my career at the National Archives and the University of British Columbia along with subsequent electronic records management consulting and digital preservation research and associated consulting activities. I should note that these reflections also have been informed by the work of a number of individuals who have made noteworthy contributions in the

[7] Dollar, C. M. (1986), *Electronic Records Management and Archives in International Organizations: A RAMP Study with Guidelines,* UNESCO, Paris.

[8] Dollar, C. M. (1992), *Archival theory and information technologies: the impact of information technologies on archival principles and methods,* University of Macerata, Macerata, Italy. This book was the outgrowth of a paper a paper I gave in 1990 at a conference on Archival Science at the Threshold of 2000: Balance and Perspective organized by the University of Macerata and a Specialists Meeting convened held at the University of Macerata in 1991 with the support of the Universata degli Studi di Macerata and the Italian Ufficio Centrale per I Beni Archivistici.

[9] A more detailed review is available in Dollar, C. M. (2004), "Trends in the Archival Acquisition and Presentation of Electronic Records: 1970-2010", in Doorn, P., Garskova, I. and Tjalsma, H. (Eds.) *Archives in cyberspace: Electronic records in East and West*, Moscow University Press, Moscow, Russia, pp. 11-36.

area of digital preservation.

I have organized these reflections into three themes:

- How we describe technology based records environments
- How we identify technology based records
- How we acquire and preserve technology based records

2. How we describe technology based records environments: from ADP (Automated Data Processing) records to digital records

The first theme traces the evolution of how we describe technology based records from ADP (Automated Data Processing) Records to Digital Records.

In the late 1960s and early 1970s computer processing was generally called "Automated Data Processing" and archivists and records managers used the term "ADP records" because it served the purpose of aligning records to a powerful new information technology. It also conveyed to the emerging Automated Data Processing Community that the new systems and applications created records, albeit in a new form, and that these records had to be addressed. By the I time joined the staff of the National Archives of the United States in 1974 Machine-Readable records had begun to supplant ADP Records because it denoted a growing recognition of the dependency on computer hardware, especially fragile storage media, and software to render into human readable and usable form records generated by computer systems and applications. A major concern was machine-readable records would become obsolescent because of computer technology obsolescence. During this period of time the use of "Computer Readable Records" was also used but eventually "Electronic Records" emerged as the primary descriptor of records that are created, used, and stored by computers, what we now characterize as "born digital records." The emergence of the term "Electronic Records" reflected a fundamental shift in information technologies as the use of Personal Computers, Desktop Applications, and Graphic User Interfaces (GUI) marked the decline of main frame computers and "dumb" computer terminals.

By the beginning of the 21st century the growing complexity and interdependencies of computer networks systems such as enterprise content management systems gave rise to digital records that were either born digitally or scanned digital image records. There was a growing understanding that records created and used by a computer only physically exist at the time they are rendered on a display or printed. Otherwise, they physically exist only as a stream of binary bits represented as 1s and 0s that must be interpreted and displayed in human readable form. Of course this has always been the case, but the use of digital records acknowledges the complexities of the systems and applications that create and store them and signals that continuing access to usable and trustworthy digital records requires keeping bit streams alive through media renewal, mitigation of the effects of file format obsolescence, and capture of metadata. Digital records also implies recognition they are part of a larger environment with multiple stakeholders whose support is essential to the identification and preservation of digital records.

3. How we identify technology based records:

3.1 From on-site surveys to functional records classification

The second theme focuses on how we have moved from identification of technology based records through on-site surveys to functional classification of digital records.

Fully developed retention schedules for machine- readable records did not exist when I became Director of the Machine-Readable Archives Division so we initially focused on what I called a Rescue and Salvage approach in which the staff visited federal agencies we thought might have magnetic tapes (and in some instances punch cards) containing records of potential archival value. Our focus was on identifying non-aggregated numeric data in reports and studies produced by main-frame computer systems. One of our top priorities was the Decennial Census of 1960, which was the first U.S census based on computer processed data This computer system had become obsolescent by 1974 and there was the real danger the Decennial Census of 1960 individual population data would be unreadable. This initiative was successful and the U.S. Census Bureau eventually transferred about 250 magnetic tapes containing micro level census data to the custody of the National Archives.[10] Another significant rescue and salvage project involved Vietnam War records maintained in the National Military Command System (NCMS) Information Processing System, commonly referred to as NIPS, which IBM developed for the Department of Defense (DOD) in the 1960s. NIPS was not widely used outside of the DOD and by the mid1970s when DOD decided to discontinue funding for NIPS, IBM ceased its support. These NIPS records were transferred to the National Archives in the late 1970s where Staff of the Machine-Readable Archives Division moved the data files to a software independent environment, using a feature of the NIPS software for stripping off file content information so that only the actual data records were written to computer tapes.

The Rescue and Salvage methodology was effective but labor intensive so around 1978 the focus shifted to the use of a general records retention schedule for machine-readable records that assigned retention periods to these records. Among other things, this retention schedule implemented the concept of "master" or "history files" that referenced the final version of reports and studies and other content of permanent archival value. Using General Records Schedule 20, the staff reviewed agency inventories of computer magnetic tapes to identify "history" or "master files" and negotiated with the agencies for their transfer along with appropriate documentation (e.g., code books) to the custody of the Machine-Readable Archives Division. In the process we identified history/master files that were software dependent and could only be used with the system or application used initially to create and use the records. This required reformatting[11] the records to eliminate this dependency. The review of agency inventories

[10] Brown, T. E. and Adams, P. (2000), "Myths and realities about the 1960 Census", *Prologue,* Vol. 32 No. 4, pp. 266-270.

[11] This is essentially the same function as transformation in International Standards Organization (2012), "ISO/IEC 14721:2012 Space data and information transfer systems -- Open archival information system (OAIS) – Reference model", Geneva, International Standards Organization.

of magnetic tapes to identify history/master files was successful but it still was labor intensive to retroactively identify and accession data files of permanent value. By the early 1980s the focus of machine-readable records of permanent historical shifted to an analysis of information systems that were likely to produce electronic records of archival value. This analysis did identify such information systems and supported setting priorities.

But this approach still was retrospective because the information systems already had been deployed and it was still labor intensive to identify electronic records of potential archival value. Consequently, electronic records archivists began advocating the incorporation of records disposition requirements into the design of information systems and applications in the hope that over time this would ensure identifying electronic records of archival value early in the life cycle of records. Unfortunately, the designers and implementers of information systems considered this an unwelcomed intrusion into operational activities that undermined efficient and cost effective operations. With this initiative going nowhere, electronic records archivists began to shift their focus from an analysis of the content of electronic records to an analysis of the functions that produced electronic records. This was a significant step forward because it enabled targeting business functions and their associated records based upon important business functions rather than on the content of the records.

Another major advancement came with the deployment of enterprise content management systems that also supported electronic recording keeping systems. Implementation of a function based records classification scheme based upon the requirements of DoD 5015.2 and ISO 15489 for the first time made it possible to identify digital records of temporary value and digital records of permanent value through automatic assignment of record retention periods to them in the ordinary course of business at or near the time of creation or receipt.

Automatic assignment of retention periods at or near the time of their creation or receipt is important but it is even more critical to identify the preservation readiness of digital records. Preservation ready digital records means they have been "transformed”" to open standard technology neutral file formats that are interoperable across multiple technology platforms over time and space. Their use mitigates the obsolescence of file formats, including proprietary ones at the "front end" of the records life cycle. Although the creation and capture of preservation ready digital records can help mitigate future technology obsolescence it cannot address legacy digital records that already exist in proprietary and obsolescent file formats. For the time being we must keep the bit streams alive in the expectation that future technologies (e.g., emulation) will provide cost effective solutions.

How We Acquire and Preserve Digital Records:

3.2 From the Acquisition and Preservation of Machine Readable Records to the Acquisition and Preservation of Digital Records and Beyond

Turning now to the third theme, how we acquire and preserve digital records. Between 1974 and about 1985 the accepted practice for

acquiring machine-readable records from agencies was for the Machine- Readable Archives Division Staff to go to the agencies and get the magnetic tapes or arrange for their transfer. The staff verified that each tape was readable and used an IBM utility to count the number of bits recorded on the tape to validate the integrity of the records (i.e., no bits had been lost).[12] This bit count was included in a documentation package. Archivists validated the content of each tape by manually comparing a print of a sample of records with the description and documentation. Any errors identified in this validation exercise were described in the documentation package. In addition, if the records were embedded in a proprietary file format manual coding instructions were written to reformat the records so they were software independent.

At this point two copies of the reformatted records were produced, a Master Copy and a Reference Copy, using new, certified IBM 9 track tapes. Again, a bit count was conducted to verify no loss of information. (We called this an accessioning procedure for machine-readable records but in fact it was a primitive form of Ingest, which is a function of ISO 14721, the Open Archives Information System Reference Model).[13] Later, Digital Linear Tape[14] 3480 and 3590 became the standard computer tape for storage of machine-readable records. The tapes were stored in a temperature and humidity controlled environment. An annual readability check of a sample of computer tapes identified any that were at the point of becoming unreadable. They were written to new tapes and this information was added to the documentation package. I should note that around 2000 Digital Linear Tape Open, which was based on an open interoperable standard and stored about 100 Giga Bytes of digital content, displaced Digital Linear Tape. By 2012 version 6 of Digital Linear Tape could store about 2.5 TBs in the same size cartridge.

Reformatting computer tapes that were software dependent was a labor intensive process that could not be sustained so we decided to shift the burden of creating software independent machine- readable records to agencies. We wrote a regulation that required agencies transferring machine-readable records of permanent value to the National Archives to encode the records in either ASCII[15] or EBCIDIC[16] and remove all non-printable control characters. This requirement addressed software dependency of flat numeric data files but it also would have reduced word processing and spread sheets to plain unstructured text, to say nothing of relational databases. Fortunately, federal agencies tended to ignore this requirement so software dependent data files still had to be reformatted.

By the mid-1980s I realized that another solution to software dependency of electronic records of permanent value was necessary. In

[12] Of course this integrity or "fixity" verification predated the use of cryptographic hash digests

[13] International Standards Organization (2012), "ISO/IEC 14721:2012 Space data and information transfer systems -- Open archival information system (OAIS) – Reference model", Geneva, International Standards Organization.

[14] Wikipedia. (2016b), "Digital Linear Tape", available at: https://en.wikipedia.org/wiki/Digital_Linear_Tape (accessed 15th January 2016).

[15] Wikipedia. (2016a), "ASCII", available at: https://en.wikipedia.org/wiki/ASCII (accessed 15th January 2016).

[16] Wikipedia. (2016c), "EBCDIC", available at: https://en.wikipedia.org/wiki/EBCDIC (accessed 15th January 2016).

1985 the International Standards Organization issued ISO 8211,[17] which identified the specifications of an information interchange format that supported the exchange of digital content in one proprietary format to another proprietary format. Its focus was on engineering records but there was no impediment to using ISO 8211 with other record types. I became a strong proponent of the use of ISO 8211 to mitigate the software dependency of electronic records of permanent value.

Unfortunately, software vendors failed to develop software to implement ISO 8211 so it languished for more than a decade before it was resurrected and implemented as the Spatial Data Transfer Format standard for Geographic Information Systems. I continued to promote the use of technology neutral file formats and the 2002 edition of my book, *Authentic Electronic Records: Strategies for Long-Term Access*[18] identified nine technology neutral formats that can be used in long-term digital preservation. The issuance of two standards in particular, ISO 19005 PDF/A[19] and ISO 14721[20], greatly accelerated the momentum for the use of open standard technology neutral formats in digital preservation. ISO 14721 describes at a high level the functions and attributes of a Trusted Digital Repository (TDR). Its widespread acceptance as the standard for digital preservation is transformational for the field of digital preservation.

In 2007 Lori and I began working on a Trusted Digital Repository gap analysis methodology that we called the Digital Preservation Capability Maturity Model or DPCMM. More will be said about DPCMM later in the Workshop but for now I want to mention two of its fifteen components: Record Integrity Validation and Open Standard Technology Neutral File Formats. Earlier I referenced the use of bit counts to validate that no bits had been lost. This was a primitive integrity validation tool because there could be bit changes without increasing or decreasing the number of bits. The developments of powerful cryptographic hash algorithms along with digital signature technologies introduced new integrity validation tools for digital preservation.

Open Standard Technology Neutral file formats are equally powerful tools. The DPCMM references them as Preservation Ready File Formats that initiate digital preservation at the front end of the Records Life Cycle when digital records are created or received. Our sense is that the work load of ingesting non-preservation ready digital records will overwhelm the ingest capabilities of most if not all digital preservation repositories. Our current view is this ingest overload can be substantially mitigated if digital preservation is operationalized in routine business processes so that at the time of creation or receipt digital records are converted to preservation ready format (e.g.,

[17] International Standards Organization (1994), "ISO 8211:1994 Information Technology - Specification for a data descriptive file for information interchange", Geneva, International Standards Organization.

[18] Dollar, C. M. (2000), *Authentic Electronic Records: Strategies for Long-term Access,* Cohasset Associates, Chicago.

[19] International Standards Organization (2005a), "ISO 19005-1:2005 Document Management -- Electronic Document File Format for Long-term Preservation -- Part 1: Use of PDF 1.4 (PDF/A-1)", Geneva, International Standards Organization.

[20] International Standards Organization (2012), "ISO/IEC 14721:2012 Space data and information transfer systems -- Open archival information system (OAIS) – Reference model", Geneva, International Standards Organization.

PDF/A). In this regard The Queensland State Archives (Australia) has initiated a Digital Continuity Program[21] under the leadership of Adrian Cunningham that systematically addresses ensuring digital records are available, usable, and trustworthy from the point of creation or receipt for as long as necessary. In effect, this Digital Continuity Program mitigates technology obsolescence and ensures digital records are available, usable and trustworthy at their creation and receipt and as far into the future as required.

4. Facing a challenging future

This morning my reflections have traced at a high level how the archives and records management professions have responded to critical issues and challenges of the digital information age in three broad areas:

(1) How we describe technology based records environments
(2) How we identify technology based records
(3) How we acquire and preserve technology based records

But what about the future, say the next decade or so? I limit this to the next decade because a decade is about as far into the future as we can project future information technology trends and innovations with any sense of confidence.

First, the next decade is likely to be an extension of a Digital Information Age in which the volume of digital content created will continue to grow almost exponentially. New digital content types are emerging - Big Data and Big Data Stacks, for example - that require rethinking our current methodologies and continuing the adaptation and evolution that have persisted over the past four decades.

Second, the likelihood is high that non-custodial digital repositories (i.e., cloud repositories) will replace many traditional custodial repositories because the benefits of economies of scale with cloud digital repositories are so persuasive to resource allocators. The archives, records management and information specialist professions will have to work diligently to ensure that cloud digital repositories conform to the specifications of ISO 14721 and associated best digital preservation practices. This is likely to involve expanding the stakeholders in digital preservation activities.

Third, ensuring that digital preservation begins at or near the time digital content is created or received requires operationalizing preservation readiness capability into business processes and digital infrastructure to ensure digital content is available, usable, and trustworthy from its creation or receipt for as far into the future as is necessary. In this regard, the Queensland State Archives Digital Continuity initiative, which I referenced previously, is a useful model. Another potentially useful model to link the capture of digital preservation ready records is the Open Government Data Initiative, especially Norway's Nettskap. Doubtless, there are other potential linkages we can explore. We simply need to be alert to these opportunities.

Fourth, much of the innovation and adaptation in digital preservation over the last four decades has been reactive. The times are different now and we must become proactive and seize opportunities as they emerge. The Digital Preservation Capability Maturity Model is a tool that can be used for this purpose. It is for this reason that Lori and I are delighted for

[21] Queensland State Archives. (2016), "Digital Continuity", available at: http://www.archives.qld.gov.au/Recordkeeping/DigitalContinuity/Pages/Default.aspx (accessed 15th January 2016).

the opportunity to explore with you the Digital Preservation Capability Maturity Model.

Fifth, Information Governance (IG) as a cross-disciplinary enterprise level framework that integrates structures, functions, processes, and controls to ensure that digital information is available and usable for legal, regulatory, operational, and business continuity purposes for as long into the future as required is gaining traction. Records management is readily acknowledged this as a core facet but little or no attention is given to ensuring the IG approach incorporates the standards and best practices the digital preservation community has developed over the last two decades. Archivists and records managers have an extraordinary opportunity and challenge to work with IG advocates to ensure this framework addresses long-term preservation issues, considerations, and accountabilities.

Thank you.

Epilogue

Since the June 2013 workshop several important developments with regard to DPCMM have taken place. In response to developments in the industry and prevailing digital preservation practices, Lori and I made updates to the model in 2014 and in 2015 which included:

- fine tuning performance metrics,
- adding definitions, and
- identifying forty-three significant (metadata) properties for Submission Information Packages (SIPs), Archival Information Packages (AIPs), and Dissemination Information Packages (DIPs).

A web enabled Digital Preservation Capability Self-Assessment tool (www.DigitalOK.org) was launched in August 2014 and is available to interested individuals and organizations at no cost. Preservica, a United Kingdom digital preservation system vendor, used the self-assessment tool to assess its cloud-based software and services offering and published an essential guide on their results at: http://preservica.com/resource/essential-guide-achieving-step-change-digital-preservation-capability

Perhaps the most noteworthy development has been the successful application of DPCMM and the self-assessment tool by the U. S. Council of State Archives (CoSA) as part of their multi-year State Electronic Records Initiative (SERI)[22]. Each of the fifty-six U.S. state and territory archives conducted a digital preservation capability self-assessment in 2012 and repeated the self-assessment in 2015. Substantial improvement in digital preservation capability over the three year period was achieved by 34 of the 56 state archives. DPCMM was also adapted and used as CoSA's State Electronic Records Program (SERP) framework[23] which provides the foundation for training and a best practice resource portal (PERTTS). Finally, at the recently completed IPres15 conference (Chapel Hill, North Carolina) the digital preservation component of CoSA's SERI project was recognized as the largest single instance of a digital preservation use case across multiple repositories.

[22] Council of State Archivists [United States]. (2016a), "PERTTS Portal", available at: https://www.statearchivists.org/pertts/ (accessed 15th January 2016).

[23] Council of State Archivists [United States]. (2016b), "SERP Framework", available at: https://www.statearchivists.org/pertts/serp-framework/ (accessed 15th January 2016).

Finally, in 2015 Lori and I published an article in the *Sedona Conference Journal* that calls for an explicit recognition of a co-dependency between Information Governance and digital preservation. The article describes Principle 9 of Information Governance, "ensuring the on-going integrity and availability of long-term digital assets"[24] as preservation by another name.[25] Information Governance is incomplete
without the explicit capabilities that ensure the availability, usability, and trustworthiness of digital information. Likewise, a digital preservation framework that is not incorporated into operational business processes through Information Governance will remain a costly and labor intensive activity at the end of the record life cycle that is likely to overwhelm the capabilities of trusted digital repositories.

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[25] Dollar, C. M. and Ashley, L. J. Ibid."Ensuring Long-Term Availability, Usability and Trustworthiness of Digital Information", Vol. 16, pp. 178-199.

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Biography

Charles Dollar holds a Ph.D. in History from the University of Kentucky and is a Fellow of the Society of American Archivists and the Association of Image and Information Management. In 2005 he received the Emmett Leahy Award for outstanding contributions to the information and records management profession. Noteworthy publications include The Impact of Information Technologies on Archival Principles and Methods (1992) and Authentic Electronic Records: Long-Term Access Strategies (1999), both of which received awards from the Society of American Archivists. While on the staff of the National Archives (1974–1994), Mr. Dollar led the "machine-readable" records program and played a major role in research projects on technology standards, storage media, integrity validation, and imaging applications related to long-term access to digital records. In 1994 he joined the Graduate Faculty of the School of Library, Information, and Archival Studies at the University of British Columbia. Five years later he became an independent consultant and in 2007 began collaborating with Lori Ashley on a variety of projects, including development of the Digital Preservation Capability Maturity Model (DPCMM) as a gap analysis tool for assessing an organization's digital preservation readiness.