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ELECTRONIC RECORDKEEPING: An Introduction

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Abstract

This paper begins with a brief overview of records and archival management before the advent of the electronic era; then describe the ways in which the definitions and constructs of archives and records management have been altered in the electronic environment; and outlines the various approaches to the challenges of electronic recordkeeping that are currently being investigated and applied.

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1. Introduction

In the late twentieth century, we live on a planet where there has been an explosion of electronic communications, connecting society in new and exciting ways only dreamed of by the thinkers of the recent past. One significant and unanticipated result of this explosion, however, has been its impact on the way individuals and organizations create, disseminate and keep their records. While society still has access to the intellectual output of sages and scholars from past centuries, important intellectual achievements of the new electronic era are already disappearing without a trace, leading to the characterization of the present period as a "digital dark age" by the more pessimistic among us (Brand).

Whether one's outlook is essentially optimistic or pessimistic, the inescapable fact is that electronic records pose new and compelling challenges to those responsible for preserving and interpreting them. These new challenges arise from the increasing complexity of the technology of documentation and from the increasing fragility of that technology over time. Moreover, the challenges posed by changes in the collection, dissemination and storage of information are so profound and far-reaching that the archival and records management professions -- indeed records themselves -- are undergoing profound change and redefinition as a result.

In this paper, I will begin with a brief overview of records and archival management before the advent of the electronic era; then describe the ways in which the definitions and constructs of archives and records management have been altered in the electronic environment; and, finally, I will outline the various approaches to the challenges of electronic recordkeeping that are currently being applied.

2. Overview and Definitions

In 1965, T. R. Schellenberg defined *records* as:

> A generic term used synonymously with the term *material*, that includes both *archives*, a term customarily used to refer to material of public origin, and *historical records*, customarily used to refer to material of private origin.

In addition to this basic definition, for the past 56 years records management and archival administration in the United States and abroad have been built, in large part, upon a fundamental construct called life-cycle management. This construct, formulated in 1940 by appraisal archivists with the United States National Archives (Brooks), holds that all records pass through the same life cycle of: creation, use, storage and disposition.

Disposition in the life-cycle of records is the point at which a record is either officially declared permanent, because of its historical value, or is officially disposed because it has ceased to have any historical or informational significance. The process of determining

the appropriate disposition of a record as either permanent or temporary is called appraisal and scheduling.

When this life cycle of records construct was first articulated in the US, most of the data and information that passed through the life-cycle steps were paper-type[1] and most were also human-eye-readable.[2] In addition, most information passed consecutively through the life-cycle; that is, creation was followed by a period of active use, which was then followed by a period of storage, which was then followed by disposition.

Accepted archival theory of the time held that the appraisal and scheduling of records, that is, the determination of ultimate disposition, should occur as early in the life-cycle of the records as possible, preferably at the time of their creation (Brooks). Common practice, however (because of a variety of factors), has often resulted in the scheduling of the records -- not at the point of creation nor at the point of active use -- but at the time they are retired to storage IF the storage location is controlled by an archivist or records manager. If not, appraisal and scheduling have typically occurred at the time of disposition.

A second fundamental construct of archives and records management, also developed in the environment of paper-type, human-eye-readable records, is the principle of physical transfer. This principle holds that records that are scheduled for permanent retention must be transferred to the physical custody of an archival repository, where they will be arranged and described to facilitate their continued use, and properly stored to facilitate their continued survival. In actual practice, however, the principle of physical transfer -- much like the principle of scheduling -- has often been abridged or ignored by records' creators and users. Massive quantities of ultimately disposable paper-type records with admittedly short-term value have routinely been transferred to records centers, while creating agents and agencies have been notoriously reluctant to part with physical custody of even small volumes of paper-type records which they consider to be historically significant.

3. The Electronic Era

Such has been the status of both records management and archival practice in the United States from roughly the end of World War II up until the mid 1960's. Since around 1965, however, practically every element in the construct of life-cycle management has undergone significant change. This shift has occurred so rapidly and across so many diverse disciplines that it has even destabilized the basic vocabulary which had been used heretofore to describe and discuss the creation, use, transmission and storage of records.

In the electronic era, the words "record" and "archive" have acquired new and very different meanings. In an Information Resource Management (IRM) environment, a *record* is simply any discrete piece of information. As the electronic and paper recordkeeping environments have drawn closer together, archivists and records managers

have been compelled to refine and expand their definition of a record in order to differentiate it from the IRM definition, and also in order to recognize and accommodate the alterations that the electronic environment has imposed. The current US government definition of a record

> includes all books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them… (44USC Sec. 3301)

While this is a great deal more specific that Schellenberg's 1965 definition, it does not go as far as the International Council on Archives' 1997 definition, which precisely addresses the way the electronic environment changes records, stating that a record is

> …a specific piece of recorded information generated, collected or received in the initiation, conduct or completion of an activity, and that comprises sufficient content, context and structure to provide proof or evidence of that activity (CIA/ICA).

In the electronic era, *archives*, the noun, has become *archive*, a verb, upon its relatively-recent migration from the vocabulary of archivists into that of computer programmers and operators, and it means something significantly diminished in the IRM context. The archives and records-management noun, *archives*, means "the non-current records of an organization preserved because of their continuing value." (NARA) The IRM verb, *to archive*, means to transfer files from a computer into off-line storage.

The diminishment implicit in the newer IRM definitions of archives and records is well summarized by Stewart Brand, who recently wrote (in another context) that

> … commercial software is almost always written in great haste, at ever-accelerating market velocity; it can foresee an "upgrade path" to next year's version, but decades are outside its scope. And societies live by decades, civilizations by centuries. (Brand)

The "decades and centuries" context of the archival definitions of *record* and *archive* are being supplanted by the "months and years" context of the electronic era.

Electronic records can be most basically defined as what they are not: not paper-type, not human-eye-readable and not permanent. Such records include those which store

information on magnetic or optical media which must be mediated or translated for the human eye (and ear) by some type of computer software, a computer operating system, and computer hardware. Electronic records are quite different from human-eye-readable, paper-based records in a number of significant ways. They are much more compact, they are easier to create, alter, and transmit; and they are, in some ways, easier to store. Some types of electronic records may appear to have the same life-cycle as that of paper-type records, but for electronic records the middle two phases of the life-cycle tend to be conflated: since creation, revision and transmission are so flexible and inexpensive in the machine environment, electronic information tends to have a longer "use" phase, and, since storage of electronic information is so compact and so easy to accomplish, "storage" tends to occur at the same time and in the same location as "use."

Accordingly, the University of British Columbia project on the Preservation and Integrity of Electronic Records has identified only two phases in the life cycle of electronic records: creation and preservation while the ICA identifies three: design, creation and maintenance. The maintenance phase of the ICA life-cycle includes preservation and use of electronic records.

The fact that the use and storage phases of electronic data occur simultaneously and in the same location has had significant negative impact on the archival principle of physical transfer**.** And, since the scheduling of records to determine their historical significance and ultimate disposition has typically taken place at the time of physical transfer into storage (even though it was supposed to occur much earlier in the life-cycle), in this wonderland of electronic records, where there is no physical transfer of records, there has tended to be no archival appraisal and, consequently, no scheduling.

The absence of archival appraisal and scheduling in the electronic records environment in and of itself could be a relatively easily-correctable problem, except that it is compounded by another important attribute of the electronic record environment: inherent instability.

A. Stability of Paper-Based Technology

The best way to demonstrate the instability of the electronic environment is by comparison to the relative stability of the prior, human-eye-readable record environment. A high-profile example of human-eye-readable documentation is the 220-year old U. S. *Declaration of Independence*..[3] The life-cycle of this document began with the collaborative creation by the Continental Congress, occurring in the city of Philadelphia, Pennsylvania, over the summer months of the year 1776. Creation of the *Declaration* was then followed by its official adoption by the Continental Congress on July 4, 1776; its approval by all of the thirteen colonies by July 9, 1776; and the signature of an official copy "engrossed on parchment" by the delegates to the Continental Congress on August 2, 1776.[4] The official, signed, parchment *Declaration* was in use by the Continental and

Confederation Congresses through 1789, at which time it began the storage phase of its life-cycle.

While there was never any question in the mind of any official of the newly-minted republic of the United States of America that the disposition of the official copy of the *Declaration* was to be permanent, the storage location of the official document has shifted a total of 28 times so far in its 220 years of existence. Furthermore, although contemporary commentary indicated that there was noticeable deterioration of the condition and readability of the *Declaration* as early as 40 years into its existence, it was only upon the 100th anniversary of its approval, in 1876, that serious, "official" attention began to be paid to arresting and possibly reversing its deteriorating physical condition. The United States' National Academy of Sciences studied the *Declaration* in from 1880-81, and again in 1903. These studies led to its temporary removal from public display in 1904 in order to limit its exposure to the deteriorating effects of excess light and humidity until appropriate protections could be devised. Further and increasingly more elaborate steps have been taken to adequately store and preserve the *Declaration* since 1904.

In 1953, the *Declaration* was transferred to the US National Archives, beginning the "disposition" phase of its long existence. It is now enshrined in a specially-designed and monitored exhibition case, within a specially designed exhibition hall in the National Archives building in downtown Washington DC.

B. Instability of Electronic Technology

By contrast, recent reports by both the Research Libraries Group and the National Research Council cite several instances of important documentation that has suffered premature extinction due to its electronic format. The RLG report details, for example, the measures taken to preserve the 1960 U. S. Census from loss:

> As it compiled the decennial census in the early sixties, the Census Bureau retained records for its own use in what it regarded as "permanent" storage. In 1976, the National Archives identified seven series of aggregated data from the 1960 Census files as having long-term historical value. A large portion of the selected records, however, resided on tapes that the Bureau could read only with a UNIVAC type II-A tape drive. By the mid-seventies, that particular tape drive was long obsolete, and the Census Bureau faced a significant engineering challenge in preserving the data from the UNIVAC type II-A tapes. By 1979, the Bureau had successfully copied onto industry-standard tapes nearly all the data judged then to have long-term value. (RLG)

Here is a modern, electronic set of documents, or more correctly, group of datasets, that the creating agency appraised as permanent at the time of creation -- note that the appraisal took place at the correct point for appraisal under the original archival construct.

A short 16 years later, however, when a stake-holder inquired about the "permanent" records, they were discovered to be in need of rescue. The rescue effort took three years, and not all of the data were able to be saved.

Other historically significant records have disappeared completely, including the first e-mail message (the sender of which can not be determined because the 1964 message is gone), and U. S. satellite observational data of the Amazon basin in Brazil in the 1970's (RLG, NRC), and many of the original pages of the World Wide Web. Whereas the "window of opportunity" to appraise and preserve a certain eighteenth-century parchment human-eye-readable document appears to have been equal to or greater than 150 years, the "window of opportunity" for electronic records, some of which is just as important, far-reaching, and life-enhancing as that treasured but admittedly ill-kept document, is substantially less than a decade, and may even be shrinking.

Backward compatibility of software beyond the latest one or two versions has not yet been a priority of the off-the-shelf software industry; and the track record of in-house programmers in this area tends to be just as bad. As a US National Research Council study states: "the greatest barrier to contemporary and future use of scientific data by other researchers, policy-makers, educators and the general public is lack of adequate documentation," and "a general problem prevalent among all scientific disciplines is the low priority attached to data management and preservation by most agencies. Experience indicates that new research projects tend to get much more attention than the handling of data from old ones, even though the payoff from optimal utilization of existing data may be greater. (NRC)

As Rothenberg has stated, "It is only slightly facetious to say that digital information lasts forever -- or five years, whichever comes first."

C. Viability of the "Life-Cycle" Construct for Electronic Records

It may no longer be helpful to view the functions of creation, use, storage and disposition as a cycle, because that construct is based on the assumption that the elements of the cycle are sequential, rather than concurrent. While the condensed life-cycle models proposed by the ICA and UBC more accurately represent electronic reality, the life-cycle concept itself may no longer be useful in the electronic era, because it supports the illusion that there exists a span of time after the generation of electronic information during which appraisal and disposition can occur. In the electronic environment, this illusion may lead to slow action or inaction, both of which lead, inevitably, to loss.

This is so not only because of the short life-spans of hardware, operating systems, software, and storage media, but because of an underlying problem not encountered in the paper-based, human-eye-readable environment. That problem is the lack of "record-ness" of electronic information.

Most electronic information systems are just that, information systems. As has been pointed out by McGovern and Samuels, to be a record, information must

> …possess three characteristics: content, context, and structure. *Content* represents the text or image of the message. *Context* is the information supplied in the letterhead, signatory lines, "cc" lines about who sent the message and who received copies, and especially any information that would relate the document to other documents and the business process or functions that caused the document to be created. *Structure* is the format of the document, such as a purchase order, registration form, or memorandum." (McGovern & Samuels)

In the paper-based environment, content, context and structure "are embedded in each physical artifact, or document." (McGovern & Samuels) Establishing the "record-ness" of human-eye-readable entities or documents is routine in the twentieth century, because such documents are relatively stable and because conventions of context and structure have been long established for them. We tend to think of these conventions as integral to human-eye-readable information, but they have, in fact, been artificially constructed over centuries of negotiation, practice, and habit.

By contrast, in the electronic environment -- particularly in the networked electronic environment -- individuals deal increasing with pseudo-records, created on-the-fly by a system which pulls information from various places in the network and displays it, for a brief moment, on the screen of the user. The electronic environment does not naturally or automatically create records: it is a "meta-medium," a set of layered services built from flexible elements, (Agre) therefore, the "record-ness" of digital objects is something that must be both consciously generated and constructively protected.

4. Current Approaches to Electronic Recordkeeping

How electronic records are going to be created and preserved is still very much an open question. Establishing persistent context and structure for electronic information in order to create electronic records will require participation in the design of electronic recordkeeping systems by archivists and records managers.

A. Creation

Electronic recordkeeping systems will have to be compliant with all legal and regulatory requirements, accountable to the creating organizations' administration, and functional over time. (McGovern & Samuels) Information in an electronic recordkeeping system, in addition to being "born digital," will also need to be born a record, born appraised, and born scheduled. The US Department of Defense has broken ground in this area with the

establishment of DOD 5015.2-STD, RMA DESIGN CRITERIA STANDARD, endorsed by the National Archives in 1998. This standard

> defines the basic requirements based on operational, legislative and legal needs that must be met by records management application (RMA) products that are acquired by the Department of Defense (DOD) and its Components. (DoD)

Records management application products developed for use by the Department of Defense will interface with or replace existing commercial products, and are expected to be adopted by both other government agencies, and by non-government organizations. As of May 15, 1999, 10 commercially available products have been tested and certified compliant with the Department of Defense standard.

A key component in the creation of electronic records in a networked environment is the establishment of consistent and persistent naming of digital objects over time. (Payette) This will involve the establishment of standards for persistent uniform resource locators (PURLs) for Internet objects, and the establishment of standards for meta-data for all digital objects. Enterprises such as The Dublin Core Metadata Initiative (http://purl.oclc.org/dc/), The International Digital Object Identifier Foundation (http://www.doi.org), and the W3C's Resource Description Framework (http://www.w3c.org/RDF/) are employing a variety of approaches to the problem of meta-data, but no widely-accepted standard has yet emerged.

B. Preservation

In the electronic recordkeeping environment, effective preservation plans for the long-term retention of records -- including realistic assessment of costs – have yet to stabilize. Strategies for preservation of electronic records abound, and no consensus has been reached concerning which of the several possible approaches is best. Schemes for preservation proposed to date include migration, conversion, and encapsulation.

C. Migration

A Research Libraries Group Task Force on Archiving Digital Information and other professional work groups have examined the fiscal and staffing implications of the brief life expectancy of electronic hardware and software. An approach to preserving electronic data that was adopted by archivists quite early in this effort is a method called "technology refreshing," which is simply periodically copying existing electronic information onto new media. The RLG Task Force has closely examined "technology refreshing" and has found it to be inadequate. What RLG recommends is a more sophisticated approach called "data migration."

Data migration "is a set of organized tasks designed to achieve the periodic transfer of digital materials from one hardware/software configuration to another, or from one

generation of computer technology to a subsequent generation. The purpose of migration is to retain the ability to display, retrieve, manipulate and use digital information in the face of constantly changing technology. (RLG) This migration process has been undertaken routinely in data processing departments of large organizations, for the migration of current data. The innovation of the RLG proposal is that it applies data migration strategies and procedures to information that is to be kept forever.

Both the RLG Task Force and the NRC Report recommend that a network of "specialized data centers" (NRC) or "certified digital archives" (RLG) be established in the United States. The RLG notes that while

> the first line of defense against loss of valuable digital information rests with the creators, providers and owners of digital information...Long-term preservation of digital information on a scale adequate for the demands of future research and scholarship will require a deep infrastructure capable of supporting a distributed system of digital archives.

The RLG Task Force further recommends an admittedly radical approach to electronic records and the problem of data-migration by proposing that

> digital archives may invoke a fail-safe mechanism to protect culturally valuable information.... Such a mechanism, supported by organizational will, economic means, and legal right, would enable a certified archival repository to exercise an aggressive rescue function... toward digital information that is in jeopardy of destruction, neglect or abandonment by its current custodian.

D. Conversion

The International Council on Archives (ICA) "Fermo Study" on Authentic Electronic Records, however, has rejected migration as a long-term preservation strategy, deeming it too complex, costly, and time-consuming to be practical. The Fermo Study concluded that very little is known "about how to plan for and execute migration of electronic records that does not result in some loss of structure, content, and context." (Dollar)

Instead of migration, the ICA group has recommended a process called conversion, which involves no change in the structure, content, or context of records, but does change the underlying bit stream. Conversion is software dependent, requiring the maintenance of copies of the original application (to be transferred from), the current application (to be transferred to) and a set of conversion utilities. These conversion utilities are also called "middleware" or "emulators." ICA recommends that conversion move electronic records from a software-dependent environment to a software-independent environment, converting them into one of the standard file formats (ex. Rich Text Format or Standard

Generalized Markup Language). Such a conversion results in the loss of some structure, but eliminates software dependence entirely.

One distinct advantage of the conversion approach is that it has been tried, and it is working well. The strategy is actually quite popular on the Internet, where fans of classic video arcade games from the 1970's and 1980's collaborate to develop emulation software that allows anyone to play the old games on a home computer – whatever make, model, or vintage that home computer might be. (Brand, Wilson)

E. Encapsulation

Jeff Rothenberg of the RAND Corporation rejects the conversion strategy, deeming it to be flawed in two fundamental ways. The first flaw he finds is that electronic objects are not nearly as standardized as they first appear to be:

> As yet, no common application is ready to be standardized. We do not have an accepted, formal understanding of the ways that humans manipulate information. It is therefore premature to attempt to enumerate the most important kinds of digital applications, let alone to circumscribe their capabilities through standards.

Because electronic records lack standardization and show no signs of developing it anytime soon, conversion strategy of preservation is, necessarily, just as complicated, expensive and lossy as migration.

But the lack of standardization is not conversion's only flaw: the main drawback of emulation, Rothenberg maintains, is that it requires detailed specifications for the outdated hardware, and the detailed specifications themselves must be maintained in a continuously readable form. Rothenberg's proposed solution is encapsulation, which seals bit streams into virtual envelopes. Under such a scheme, the enclosed bit stream is preserved verbatim, and it is described by contextual information on the outside of the virtual envelope. The contextual information, or bootstrap, is more extensive than metadata, but not as extensive as a program. The encapsulation bootstrap would be in a simple, standard format, and would describe the both contents of the envelope and the history of the processes that have been used to bring it forward to the present. The bootstrap could be converted over time, but the bitstream inside the virtual envelope would remain unchanged.

5. Conclusion

The way individuals and organizations create, disseminate and keep their records has changed unalterably in the electronic era. Whether society continues to have access to the intellectual output of our time, or whether this era becomes the "digital dark age" that some foresee, rests entirely on the abilities of archivists and records managers to work

creatively with each other, and with the computer and networking professionals who are busily constructing and changing the electronic recordkeeping landscape around us. We are only at the beginning of the electronic era, and the solutions we envision at this moment may not stand the test of time. It is our duty, however, to keep at our task, to continue to develop and test new solutions, until we have found a way to make records "live by centuries," so that the authentic history of our times – the good, the bad, and the middling – survives to inform, delight, astonish and perplex posterity.

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NOTES:

[1] I am using the term "paper-type" to denote fiber (paper, papyrus, etc.) as well as skin (parchment, vellum) writing and printing media, because my emphasis is on the physical characteristics of the media as they relate to storing and accessing the information, rather than the organic or chemical attributes of the media.

[2] There have been some paper-type records which were NOT human-eye-readable, for example, paper data punch cards and paper punch tapes. Although interesting for several reasons, these media typically have served as processing instruments rather than records, and hence, are not addressed by this paper.

[3] Information about the history of the US Declaration of Independence from the National Archives and Records Administration's "On-line Exhibit Hall" exhibition "The Declaration of Independence" (http://www.nara.gov/exhall/charters/declaration/decmain.html) and "The Declaration of Independence: A History (.../declaration/dechist.html)

[4] ibid. Not all delegates who signed the Declaration were present on August 2, 1776.