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Cultural Memory in Danger: Sustainable Information, Preservation, and Technology in the Humanities: A Theoretical Approach

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Abstract

Management of library collections is an inherently collaborative process. Spanning multiple generations, materials are selected that support user communities, as librarians strive to achieve optimization of storage and access at the lowest cost.[i] While established partnerships are crucial for the survival of libraries, within any cooperative network, there exist opportunities for divergent practices. Alternative initiatives may have progressive intentions, but competing systems and groups have the potential to disrupt recognized standards and infrastructure, some of which can prove detrimental to information organizations.

Abrupt format changes and technological advancements have altered the ways in which materials are currently acquired, accessed, and preserved. Despite advantageous possibilities arising from the evolution of material formats, convoluted access processes have imposed problematic barriers within academic libraries, particularly for humanities disciplines.

The accelerated change of formats has placed materials within a liminal construct: the composite of past, present, and emerging technologies and formats, simultaneously interacting in information organizations. The heterogeneous mixture of content necessitates concurrent navigation of physical and digital environments to conduct research. As a measure of counteracting these obstacles, collaborative initiatives have produced the network connection,[ii] pooling physical and technological resources to theoretically stabilize and consolidate collections.[iii] In many instances, however, the network connection fails to meet user expectations and needs of humanities scholars.

A sustainable, collaborative network is critical for continued access of humanities resources. At present, instability increases as provisional products, standards, and proprietary models arise; operating in isolated or capriciously compatible systems, such conventions contradict the supported outcomes of information organizations: to increase access, simplify usability, and sustainably preserve content. Negligent, divergent collaborative models inevitably destabilize the network connection by increasing systemic entropy. Sustainable practices must be facilitated in a concerted effort by authoritative information organizations, effectively aiding the reduction of information entropy. Otherwise, the risk of losing cultural memory in the humanities becomes an alarming possibility.

Keywords: humanities, digital humanities, entropy, libraries, augmented reality, network connection, collaboration, preservation, sustainability, consortia

Introduction

Collaboration is a vital component connecting the extensive array of technical functions and patron services in information organizations. Such operations as interlibrary loan have generally democratized access to resources regardless of institution, even expanding borrowing privileges to selective content in special collections and archives.[1]

Materials processing has been significantly enhanced by OCLC WorldCat MARC records (including OAIster open access records).[2] The vast repository of metadata and cataloging records has generated more efficient and consistent workflows in technical services departments, expediting access to new content for patrons.

The formation of, and participation in consortia offer considerable value to libraries—with services including negotiating favorable purchasing deals, spearheading shared print and digital preservation projects, and granting access to immense repositories of content. Harnessing the power of multiple libraries and information organizations elicits strategic directions for guidance in the contemporary information environment.

Among institutions formally or informally united by utilization of the same integrated library system, shared system queries via the cloud and LISTSERVs provide invaluable advice and training for librarians. In a larger scope, library literature documenting case studies and research empower librarians to apply practical solutions to issues encountered in the profession. Reliance upon group assistance occurs in innumerable ways to strengthen the versatility of academic libraries.

Just as collaboration can prove beneficial, it can also induce adverse side effects, inimical to the sustainability of information organizations. Oversight risks damaging consequences, and requires a holistic assessment of the network connection to identify problematic functions. As information organizations continue to expand in the digital environment, it is critical to ask, "Is the network connection empowering or hindering research in the humanities?" It is theoretically proposed that in certain instances to be examined, our overextension of collaboration in the digital environment demonstrates unsustainable access and preservation methods, evidenced by data loss. It further suggests the potential for larger pockets of data loss in humanities content are possible if precarious practices are not rectified.

The Current Limiting Factors of Library Collaboration

Capacity and Organization

Among shared discourse on the future of libraries, the concept of finite capacity is increasingly problematic. In an organization that demands continual accession, the present trend of sacrificing stack space for learning spaces[3] is becoming a contentious issue.

Proponents of expanding user spaces cite trends of declining circulation statistics, the high-cost of maintaining traditional stacks,[4] increased electronic resource use, and greater patron demand for collaborative spaces.[5] Conversely, advocates for retaining physical collections contend such conditions protect essential humanities research practices of browsing and serendipitous discovery.[6,] Irresolution of this debate is particularly concerning, considering "space reclamation"[7] of humanities collections have already occurred at Syracuse University, with similar plans being ventured at the University of Wisconsin at Madison and the University of Texas at Austin—slating the entire Doty Fine Arts Library for repository storage—for the purpose of renovating the previously occupied area for a makerspace

floor.[8] (However, both initiatives were promptly reconsidered after vehement protests by students, faculty, and the library community at-large).[9]

Ideological differences have compelled a need for compromise and alternative storage options. In addition to high-capacity shelving,[10] automated storage and retrieval systems,[11] and high-density annexes on or near campuses,[12] libraries are developing collaborative storage networks through inter-university partnerships,[13] regional university system agreements,[14] consortia efforts,[15] or as nationally organized repository systems.[16] While storage collaborations have mitigated collection capacity constraints and preserved materials, lingering effects persist as a result of user separation[17] from resources (resource displacement), producing significant obstacles in research processes of humanities scholars.[18]

In addition to high-density or shared collections, the transition from print to electronic resources sought to liberate libraries from space limitations. In many respects it was a successful plan, but the consequences of format substitution have shifted the problems of spatial restrictions to technological literacy. Commonly recognizable databases, such as Artstor, JSTOR, and the MLA International Bibliography offer extensive collections of content at the convenience of an electronic device. In spite of these advancements, the continued production of print,[19] electronic resources, and data[20] has subsequently inhibited strategic acquisition, organization, and access in a meaningful context. Information escalation-continually produced resources on a large scale-has concomitantly magnified resource displacement, resulting in immense volumes of information operating on multiple electronic platforms, and print material existing in discordant physical locations. Repercussive impediments have compromised the collaborative mission of libraries and information organizations: to improve usability and retrieve relevant content.

Library Budget

The reduction of space and purchasing power[21] have persuaded libraries to seek alternative means of provision and cost-saving measures. The decline of monographs and media purchases, and therefore, decreased access to these materials have been temporarily resolved by the use of rentals,[22] demand driven acquisition programs, shared consortium electronic book plans,[23] and aggregators combined with interlibrary loan.[24]

Journal subscriptions, subjected to higher inflation rates and more access restrictions, have resulted in the use of pay-per-view services,[25] interlibrary loan, illegal faculty file sharing,[26] tailored journal packages, and subscriptions to, or cancellation of[27] Big Deal packages. Regardless of method, libraries are adversely impacted by reoccurring "service fee" increases and inflation, or remain forcibly wedded to costly packages (of mostly low-use journals), but contain a small number core titles required for accreditation. Increased production of resources and unsustainable vendor practices have actualized severe collection gaps and reduced access to research materials.

The present environment of spatial and budgetary constraints is pressuring libraries to seek outward collaborators, as we have failed (or have been set up to fail) to meet internal user needs in the current information climate.

Network Connection

Collection deficiencies are positioning libraries to actively participate in "network connection."[28] Network connection relies upon extended partnerships of libraries, information vendors, and information professionals maintaining a system of shared resources, storage

space, standards, and technologies. Libraries and information organizations collaboratively function within the network, determining the capacity to which they can mutually contribute to, or receive support from the collective system. Although optimistically beneficial in many areas, a lack of sustainability and guidance by leading information organizations threatens the access and preservation of resources.

Humanities Research and the Network Connection

Libraries exist as a fundamental component of humanities research, as the physical building, print collections, and electronic resources are perceived as analogous to laboratories in science disciplines.[29] The deficiencies of electronic bibliographic databases,[30] and the high use of print monographs,[31] particularly interdisciplinary resources,[32] necessitates browsing physical stacks for serendipitous discovery.[33] Interaction with original objects, or in lack thereof, surrogates or high-quality digitized images,[34] is also a cardinal need for research; such evidence concludes that physical spaces are inextricably linked with humanities scholars.

While electronic resources have provided a treasure trove of materials previously inaccessible or undiscovered (e.g. Early English Books Online), scholars have consistently deduced that electronic image preservation available through the network connection is below standard.[35] Humanities scholars have discovered that many journals are incompletely scanned (e.g. JSTOR), omitting important cultural artifacts such as front and back covers, ads, minor features, main articles, tables of contents, letters to the editor, society news, and classified ads.[36] E-book and resource removal from databases without notice is prevalent,[37] occurring in, but not limited to ProQuest Ebook Central[38] and even JSTOR,[39] posing a major threat to information access and preservation.[40] These practices are considered unconscionable to humanities scholars, who are expected to be stewards of the cultural record. It has been rationally concluded that the print medium is a better method of ensuring long-term preservation and contextual integrity,[41] reducing the chance of distorted perceptions and analysis from low quality and incomplete works.[42]

Increasing partnerships between libraries and the digital humanities have further altered the dynamic of the network connection, adding open access content to the system. Notwithstanding the potential benefits associated with the digital humanities, such as the creation of free, novel, and competing content to proprietary commercial products, the network must attempt to accommodate highly ephemeral sites,[43] which increase disorganization (entropy) in the system. These problems must be addressed to successfully integrate digital humanities within the network connection.

Storage and budgetary constraints, increased information production, and the instability of the digital humanities have actualized the phenomena of resource displacement (RD) and information escalation (IE) within the network connection. Internal limitations of storage capacity have resulted in materials residing in multiple locations within and external to the library:

- Library Branches and Department Libraries
- Storage Annexes
- Government Documents
- Special Collections
- Microform Cabinets
- Print Periodicals/Serials Shelves
- Media and Audio-Visual Collections or Centers
- Course Reserves
- Children's Literature Sections
- Curriculum Materials
- Oversize Books
- Print Reference Collections
- Map Drawers

- Leisure Reading Sections and New Materials
- Misshelved or Lost Books
- E-Resource Platforms (high or low quality)

External pressures of budget cuts and information production have resulted in the adoption of alternative cost-saving measures:

- Interlibrary Loan
- Monograph Rentals
- E-book Packages
- Demand Driven Acquisition Programs
- Demand Driven Steaming Audio/Visual programs
- Shared Print and Electronic Resource Partnerships
- Database, Journals, and Aggregator Cancellation Projects
- Reliance on unstable Digital Humanities Projects
- Illegal File Sharing
- As a worst-case scenario, Inaccessible Content Due to Copyright Restrictions

While the initial purpose of the network connection was designed to expand access, negative aspects such as resource displacement, copyright restrictions, complex interfaces,[44] and inconsistent access and preservation have reduced scholars' ability to locate and retrieve relevant information. Such conditions hinder humanities research, and generate the convoluted scholarly biome within the network connection: the liminal environment.

The Liminal Environment

The convergence of libraries, vendors, and digital humanities projects have produced a liminal environment. The liminal environment is a construct containing the multi-format collection of past, present, and emerging technologies and resources, as a result of resource displacement and information escalation. Scholars are de facto placed within this setting, participating in a constant struggle to use older (perhaps obsolete) formats, while adapting to cutting edge technologies to stay current in the field. The network connection encases the boundaries of liminality, yet those boundaries are arbitrarily defined and continue to expand through information escalation, resource displacement, and superseded technology at an unrelenting pace. Connectivity has expanded access, but has neglected to address the most important limiting factor of the network connection, namely entropy: the ever-increasing disorganization caused by the unsustainably of capriciously connected and questionably compatible resources.

Entropy

Information Entropy

Shannon's Information Theory indicates that a more predictable, fixed system correlates with less disorder, or a lower calculated entropy value.

As this concept applies information systems, a system containing fewer resources of similar complexity will generally have less entropy than a system containing many connected resources of similar complexity; entropy will continue to increase as the system adds more resources and becomes increasingly complex and less predictable, therefore generating more disorder. Systems with compatible resources (standardized context) will contain lower entropy than systems that are semi-compatible or incompatible (altered context), requiring more complex technical workarounds and higher entropy to make the system function.

However, in the network connection examined in this paper, Shannon's theory can no longer be applied; as the network connection and context are not fixed, changing unpredictably and rapidly throughout the system, it requires an evaluation outside the conceptual framework of traditional information entropy theory. Collaboration

becomes inhibitory in the case of network connection, as entropy increases through the interaction and addition of multiple systems running in parallel, and sharing information connections on a compatible, semi-compatible, and incompatible random basis. Such activity renders it nearly impossible to gauge whether content is active, obsolete, or preserved for permanent storage; a calculated entropy value can no longer be ascertained to effectively maintain the infrastructure of the system. The inability to fully access and manage content prevents adequate procedures to ensure the sustainable preservation of humanities resources.

Access Entropy

Divergent and outdated access methods pose significant operability challenges to the network connection. In many cases, technological improvements in the network connection have not progressed at the same rate to accommodate or become compatible with emerging technologies and standards.

Discovery services and electronic resources are continuously changing systems infrastructure to create more advanced and marketable features. Nascent technologies of new media and augmented reality exist as multiple products and versions,[45] and require multiple APIs (and coding languages) to query databases to provide[46] real-time updates;[47] in many instances, connection to the internet[48] and/or GIS signals is necessary for these discovery and way finder services to function properly.[49] Therefore, the network connection must provide consistent access upgrades of its technological infrastructure to overcome divergent access services and to maintain stable connections to information resources. As the network connection is a partnership of individual organizations, this creates an admixture of compatible, semi-compatible, and incompatible resources increasing entropy within the system.

Aberrant metadata standards limit the functionality between discovery systems and the network connection to retrieve relevant data. In addition to Resource Description and Access (RDA) and Anglo-American Cataloging Rules (AACR2), the Digital Curation Centre lists more than thirty metadata standards used by information organizations.[50] Variations in metadata (or no metadata) used by vendors, libraries, and digital humanities projects can result in pulling irrelevant search queries, or omitting relevant content due to faulty protocols.

Proprietary technologies and indexing repositories from commercial vendors can limit the effectiveness of access in the network connection. The augmented reality system ShelvAR was discontinued as Amazon owns a pre-existing patent of similar technology.[51] Commercial discovery services, such as those owned by EBSCO and ProQuest, but not limited to only these vendors, do not fully share complete indexing data with one another.[52] Minimal efforts have been made to collaborate through poorly constructed APIs,[53] which are needlessly complicated. Proprietary obstinacy obstructs compatibility of systems in the network connection and provides patrons with different results despite subscribing to the same content while utilizing competing discovery systems.

Such issues illustrate glaring, missing links in the network connection that separates the user from sources of information. Multiple divergent standards, incompatible systems, and proprietary barriers are straining the network connection, as it is forced to develop ad hoc, unstable solutions to provide access to information.

Preservation Entropy

Current production and preservation methods ignore systemic entropy in the network connection. Preservation is reliant upon sustainability and interoperability, and yet many preservation

services are rarely interconnected (often operating in parallel rather than connected), with many commercial vendors and repositories choosing not to partner with authoritative preservation organizations. Numerous vendors irresponsibly backup information through local hosting servers or privatized preservation companies. Organizations such as the Digital Preservation Network (DPN) and Meta Archive preserve content chosen by libraries on a selected basis, self-creating intentional content gaps. Such practices are moving toward a level of entropy that can no longer be sustained. Information professionals have failed to analyze the collaborative network connection from an external perspective, a tremendous oversight that will potentially result in format obsolescence and information loss.

The preoccupation with immediate access of information has subsequently resulted in the neglect of sustainable preservation practices. Competitive and exclusive partnerships create disorganization (entropy) in the preservation management of information. The following organizations represent only a small sample of preservation networks and digital projects available in the information environment:

Preservation Networks

- LOCKSS
- CLOCKSS
- Portico
- Internet Archive
- Internet Archive – Archive-IT
- Digital Preservation Network (DPN)
- Meta Archive
- Western Regional Storage Trust (WEST)
- Shared Monograph Print Networks
- Iron Mountain – National Underground Data
- Center for Research Libraries
- Amazon Glacier Cloud Storage
- DuraCloud
- bepress Digital Commons

Content Producers with Preservation Intentions

- JSTOR/Artstor Dark Storage Initiative (Portico)[54]
- Perseus Project
- Google Books
- ProQuest – Partnered with Iron Mountain
- OCLC CONTENTdm
- Alexander Street Press Media Hosting Service
- HathiTrust - Mirrored sites at the University of Michigan and Indiana University

Preservation requires exorbitant costs, which are subsidized by subscription fees, library consortia memberships, or grant money to support digitization and infrastructure. With the current budget limitations of libraries, the information environment exists at a juncture where it cannot sufficiently pay for both access to materials and preservation services.

Reliance upon vendors to preserve content can set a dangerous precedent for how academic libraries provide long-term perpetual access. "The problem, mostly unaddressed, of long-term retention of electronic books [electronic resources] is critical. It is not acceptable for the publisher or aggregator to be the 'guarantor' of long-term security of titles."[55] The values of publishers are not necessarily in line with those of libraries.[56] "Because a publisher or aggregator has the expectation of future revenue from its stock doesn't mean it will hold indefinitely when the ebook [e-resource] is no longer profitable."[57] Indeed, we do not currently look to publishers for access to out-of-print titles – we look to libraries. The same should be said of ebooks [e-resources].[58]

Disconnected organizations and services prove contradictory to the goals of preservation: sustainable collection, organization, access, and protection of resources. The same inefficient

methods of preservation derive from the root of the original causative problem; myopic or random selectivity of preservation is, in essence, emulating the capricious production and access to commercial information resources. Continued practice of these methods suggests a high probability that access and preservation will fail to keep pace with information production. The increased entropy generated through resource displacement and information escalation is a glaring oversight with the potential for severe repercussions when combined with precarious preservation processes.

Entropy of the Network Connection

The increasing entropy of the network connection is the result of its inability to organize information production and preservation. Increasing entropy beyond the threshold predicts pocket data loss. The ability or inability to sustainably preserve content will determine how large or small that loss will be.

Proposed Solutions to Reduce Entropy

Entropy poses a severe threat to destabilize the network connection to the extent of humanities data loss. It is proposed that several initiatives, under cooperation and guidance of authoritative organizations, could develop sustainable processes to counteract negligent practices and ideally shift toward network equilibrium.

The proposed solutions are not exclusive to humanities content; they would likely offer considerable benefits for social sciences and sciences disciplines, as well as to public, state, and federal libraries. While the focus of the paper is primarily humanities, all disciplines contribute to the network connection. Synchronized action would contribute to added stability, and cooperative models adopting successful outcomes would greatly enhance the probability of accomplishing necessary outcomes.

The introduced solutions to reduce entropy involve a series of strategic steps, beginning at the localized level, and moving toward larger, association-supported initiatives. Such actions are recommended, as the suggestions can operate in parallel to illustrate examples of success, and create a supportive foundation to prompt a focused vision,[59] as well as buy-in to develop influential collaborative partnerships.

The ideal solution seeks to actualize three consortia: (1) legislative, (2) access, and (3) preservation. In lieu of investing in exorbitant labor costs to address problems at the institutional level, through the minimal financial backing of many participants, efficacious and cost-effective consortia could be developed as highly influential organizations to defend library interests. Such consortia could also consolidate current organizations and standardize access models to reduce entropy of the network connection. Partnering organizations could include representatives from, but not limited to: the American Library Association, the International Federation of Library Associations and Institutions, the Society of American Archivists, the International Council on Archives, NASIG, HathiTrust, the Digital Public Library of America, SPARC, the National Endowment for the Humanities, the National Endowment for the Arts, the Alliance of Digital Humanities Organizations, the Humanities, Arts, Science, and Technology Alliance and Collaboratory, and the Library of Congress.

Budgetary Constraints

1. Libraries should adopt an official stance refusing to sign licenses with a non-disclosure clause. Cornell University[60] is a leading defender of this position, indicating that non-disclosure agreements prevent libraries from "negotiating cheaper rates by citing an advantage obtained by another library."[61] Cornell's extensive list of publishers willing to waive non-disclosure agreements suggest emulation of this practice should be widely executed by all libraries. Such

actions could enable sharing of licensing terms (and the subsequent creation of databases comparing licensing terms), empowering libraries to negotiate more equitable and sustainable prices for resources.

Fair negotiation would readjust pricing models to a more realistic market value. While this solution could be viewed as harmful to publishers, it could prove beneficial as it may increase the number institutions able to purchase affordable content.

2. The Berlin Declaration on Open Access to Knowledge in the Sciences in Humanities[62] should be supported as an aspirational vision for the provision of open access knowledge and cultural heritage. The declaration in itself does not constitute a formal and binding agreement; libraries should, however, bolster this endeavor by advocating for university open access mandates[63] requiring scholars to provide a copy of their publication in an open access repository.

3. The creation of a consortia specifically focusing upon legislative protection of humanities resources. Unlike Projeckt DEAL,[64] a German organization that attempts to negotiate fair prices and access directly with vendors, it is suggested that libraries bypass vendor mediation (as such tactics are noticeably ineffective) and focus upon legislative action that would prove more tenable. The Fair Access to Science and Technology Research Act (FASTR) and memorandums by the Office of Science and Technology Policy provide quicker access to publicly-funded science research.[65] A well-organized legislative consortia could appropriately fund legal advisors and lobbyists to influence the passage of similar acts, thus protecting open access through reducing embargoes and ensuring preservation of humanities content.

Bridging the he Liminal Environment

1. It is suggested that virtual reality (VR) and augmented reality (AR) have the potential to overcome the limitations of the liminal environment (and the barriers of current humanities research), by embedding the patron in a unified physical and digital environment, "imitating the embodied browsing processes that take place in the physical stacks."[66] With these practices, it is hoped that researchers will possess access to the full-range of resources available.

2. Libraries should continue to support library-driven AR and VR initiatives, such as Minrva.[67] The Topic Space module (now Minrva app) at the University of Illinois at Urbana-Champaign appears to be the most promising development of AR for use in libraries. The open-source program uses OCR and barcode recognition to generate a list of resources nearby, in addition to suggesting items of similar interest with the Wayfinder feature; a map is embedded in the system and guides users to the general area of the stacks where items are located.[68] It also displays what books should normally reside on the shelves (shelf order), indicating the status of those materials-checked out, lost, missing,[69] on course reserve, etc. The expanded version of the app also helps the user to manage library services including course reserve, checkouts, fines, etc., potentially connecting users to the full array of library services and resources.

3. It is essential that the participatory environment be user friendly, technologically compatible, and intuitive to properly converge research methodologies with minimal interference.[70] In its current state, use of VR and AR in libraries appear propitious, but divergent standards minimize the effectiveness of these tools. Augmented reality systems exist as multiple products and versions,[71] and require multiple APIs (and coding languages) to query databases to provide[72] real-time updates;[73] in many instances, connection to the internet[74] and/or GIS signals is necessary for discovery and wayfinder services to function properly[75] (causing increased access

entropy). Therefore, it is essential that divergent standards and access models become compatible, or incompatible standards be discontinued to increase research capability and reduce entropy in the network connection.

Access Entropy

1. Although scholarly literature has identified isolated limitations in the information-seeking environment, the library and information science field has neglected to responsibly assess the holistic impact of these outcomes and the consequences of interoperability failure. In order for humanities resources to survive and be preserved for future generations, information professionals must advocate for the development of sustainable standards,and adhere to the standards)to establish a compatible and stable network connection that reduces system entropy.

2. A consortium should be created for the specific purpose of focusing upon access standards: metadata, protocols, programming, and format. A shared vision must focus on the creation of, and adherence to selected standards. It is essential for sustainable access and preservation that systems are compatible, suggesting that use of divergent and incompatible standards be discontinued.

Newly developed initiatives, such as Bibframe, are in the process of transforming MARC21 into web friendly bibliographic data.[76] In addition, companies like Zepheira are attempting to place library records online for easier discovery through search engines.[77] Information organization should support the continued development of Bibframe (a Library of Congress project) to ensure consistent description standards and access.

3. Consortia and libraries should encourage or demand that vendors and digital humanities projects adhere to approved access standards to reduce system entropy and enable optimal discoverability of resources. A consortium of this nature could work with vendors and digital humanities groups to select appropriate standards for their resources. For obstinate vendors, the consortia could serve as a watchdog group, informing libraries of vendors that hinder access by using divergent or proprietary standards, educating librarians on which products provide the most user friendly and compatible services. Such pressure may influence vendors to adopt unified standards, at the risk of losing business to vendors that are compatible with the network connection.

Preservation Entropy

Although JSTOR is attempting to establish an endowment to preserve resources,[78] they are one of the few content providers working with libraries to create sustainable preservation practices. Among countless smaller organizations that seek stabilized access and preservation, initiatives for promoting and implementing sustainable practices must be driven by nationally-recognized, influential organizations.

1. A consortium should be created to focus upon proper preservation of materials and develop a sustainable preservation network. A shared vision may have the following goals (including but limited to):

2. Partnering with existing, successful interdisciplinary models (e.g. sciences) to develop a large repository for humanities materials – reducing the number consortia and organizations as suggested earlier, therefore having access to greater levels of funding. A large, hybridized humanities database could be developed borrowing existing infrastructure from current humanities, social sciences, and sciences databases. For instance, advice could be sought from developers of infrastructure in such models as:

- PubMed:indexing, abstracts, and full-text articles
- Digital Public Library of America:texts, videos, and sounds
- OAIster:Open access resource union catalog
- Perseus Project:artefacts and text digitization – long term operation– 1995 to present), and
- Europeana:art, artefacts, books, and sounds

From these models, it may be possible for a large consortium to fund the creation of a product comprising the best aspects of these resources. As a secondary choice, it may be more efficient to choose a model (e.g. Europeana or the Digital Public Library of America), and partner with such a group (if a shared vision can be established) to enhance the resource to accommodate desired outcomes.

3. Adhering to preservation standards – Libraries, information organizations, and vendors need to adhere to the use of professionally accepted preservation processes and format standards. Consortia or libraries should favor the use of "approved" preservation networks, such as LOCKSS, CLOCKSS, Portico,[79] etc. It is believed that favoring such practices will convince vendors to select these standard preservation models and discontinue the use of locally-hosted (potentially unreliable) or divergent standards, thus reducing entropy in the system.

4. Libraries with a print equivalent of an e-book should retain the print copy if WorldCat holdings show fewer than 100 copies world wide. Specifically for image heavy monographs, which are often subjected to image use licenses (typically five years of use), this would aid long-term access and preservation. The preservation of electronic only books will need to be investigated further, possibly by the legislative consortia to secure preservation rights and access without violation of copyright law.

5. For digital humanities sites (and perhaps for the large, hybridized site suggested earlier), a preservation consortium should invest in few preservation services, and rely upon mirrored sites to ensure preservation and ease of access (e.g. The Perseus Project is hosted by Tufts University, with mirrored sites at the University of Chicago and Max Planck Society).

If the above recommended practices are disregarded, it is highly probable that access and preservation will fail to keep pace with information production. The increased entropy generated through spatial capacity and budgetary constraints, and access entropy is a glaring oversight with the potential for severe repercussions within the preservation process.

Discussion – Failure to Address Solutions: Consequences

Data Loss

The relative stability of physical materials afforded the security to experiment with digital resources, and stretch our capacity for information production, collection, and access with minimal risk. In the absence of a stable, time-tested digital equivalent, the expansion of technology into new formats and access models runs the risk of increased entropy and accelerated format obsolescence.

If institutions collect an array of new technology before they are ready to preserve in a proactive manner, loss of files and the integrity of the work may be compromised. This may prove highly costly and labour intensive to retrieve or restrict at a later date.[80]

There exists an underlying worry among humanities scholars that format instability will result in the loss of the scholarly and cultural record.[81] This fear is not unwarranted, given the historical destruction of libraries and the decay of ancient materials occurring over time,[82] even in the twentieth century.[83] Many classical works

exist in name only through the *Naturalis Historia* and the *De Architectura,* or as partial records unearthed in fragmented tablets in ancient libraries. In the modern era, it is estimated by the Library of Congress that seventy-five percent of silent films have been lost.[84] At the macrolevel, many websites have disappeared (or nearly disappeared) entirely from the cultural record. Such reasons include (1) Neglect, (2) Technical issues, (3) Financial instability, (4) Natural disasters, (5) Political pressure, and (6) Web wars of acquisition and discontinuation.[85] Examples include:

The Voice of the Shuttle (VoS), hosted by UC Santa Barbara: Once a comprehensive index of scholarly humanities websites, it now contains links to many web pages that are no longer updated. Broken links,often referred to as "link rot,"[86] are prevalent, highlighting websites that have disappeared[87] or have changed domain names, decreasing the findability of resources.

My History is American History:[88] A website developed in 1999, funded by PSINet, Genealogy.com, the NEH, and Bill Clinton's White House Millennium Council, *My History is American History* aimed to promote personal history among a popular audience." After the dot-com bubble burst (and a lack of NEH monetary support), invaluable personal interviews with American icons and historians were permanently lost. Only a handful of interviews and webpages can be accessed by the Wayback Machine.[89]

The BBC Domesday Project: The Domesday Book, a medieval document recording landholdings, income, and professions in England was digitized onto two laserdiscs in 1986, costing £2.5 million. By 2002, the laserdiscs were nearly unusable due to their obsolete format.[90] After extensive work and cost to recover the data, it was finally placed online in 2011.

Geocities: A vibrant community of approximately 38 million personal websites was discontinued by Yahoo! after 15 years of operation. While the Internet Archive[91] Wayback Machine and OoCities.org[92] have been able to preserve some content, much of the GeoCities community has been lost, especially non-indexed pages and websites with lower web traffic. A significant amount of cultural information about the 1990s has vanished as a result of ceased operation.

Library.nu: Formerly Gigapedia, the P2P website Library.nu contained between 400,000 and a million digital books for free, with materials spanning across sciences, social sciences, and the humanities disciplines. It was eventually shutdown in 2012 due to claims of copyright infringement.[93] While the battle continues between copyright holders and advocates of the free dissemination of information, valuable information aggregated in this central hub disappeared from the Internet (or was dispersed, decreasing discoverability).

Project Bamboo, a $1.4 million-dollar grant from the Andrew W. Mellon Foundation, was established to create a stable cyberinfrastructure for the digital humanities.[94] Including 600 participants at 115 institutions, the members consisted of humanities researchers, computer science researchers, information scientists, librarians, and campus technologists.[95] Lack of shared vision, staff turnover, and discontinued funding caused the project to disband in 2012.

Failure to learn from these examples presents opportunities for the list to grow, as more websites will follow suit. Sustainable access, preservation, formats, and funding are imperative to reduce the chance of further loss of resources and data.

Format Instability and Data Recovery

While format obsolescence is recognized among information professionals,[96] it is suggested by some scholars that data loss will not occur on a

scale as large as previously feared. Collective efforts between programmers and the network connection have produced open source technology to recover digitally obsolete formats; however a caveat exists in this assertion – recovery can only be completed if the bytes are available for retrieval.[97] In a typically leased information environment, this presents major barriers for restoration.

Realistically, the argument for reclamation is partially reductionist, specifically to the context of humanities, due to intrinsic flaws plaguing information production and preservation of these disciplines. Copyrighted proprietary software can restrict format migration of digital materials,[98] preventing select titles from being reformatted for long-term preservation,[99] especially among temporarily leased electronic images.[100] This limitation extends to vulnerable physical formats, such as video cassette tapes and audio cassettes, which cannot be reformatted for mass distribution (but potentially only at the local access level).[101] The less-profitable value of humanities materials leaves content less likely to be reformatted by commercial information vendors who own the reproduction rights, and are subject to decay and permanent loss from the cultural record.[102]

Open source software like OpenOffice and virtual machines distort proprietary textual and image formatting, font type, and color schemes.[103] The need for original, contextual manifestation[104] or a high-quality surrogate hinders proper preservation and long-term access for humanities materials.[105] Entropy is therefore, not only added through distortion of formatting and context, but the practice of content omission for the sake of convenience, copyright restrictions, and speed of preservation.

It is estimated that data storage technology and reformatting efforts should be conducted every five years to reduce the chance of obsolescence. However, the cost of maintenance and platform migration is complicated,[106] and the rendering of exact reformatted copies is exponentially expensive.[107] Recovering information from obsolete media, as well as reviving abandoned digital projects can be a laborious and time-consuming effort,[108] often involving numerous technologies and collaborative partnerships to extract, reformat data, and check for viruses.[109] This cost may be higher than what the network connection can afford. Networked digital humanities centers, Internet projects, institutional repositories, and small-scale publishers do not possess the funding for continued operational expenses in this capacity[110] or are making slow progress in implanting preservation strategies.[111] These factors place humanities data at risk for obsolescence and loss.

In some cases, personal archiving is required. Tools such as HTTrack,[112] Internet Archive Wayback Machine Save Page Now, and Archive-IT[113] allow for personal or institutional archiving of websites, but these bytes are only recoverable if the source of information ("inadvertent archivists")[114] and/or project can be determined. In other instances, organizations such as the Church of Scientology have prevented preservation or indexing of websites critical of their ideologies. Under threat of litigation for dubious claims of violating the Digital Millennium Copyright Act, the Internet Archive removed preserved pages of Xenu.net,[115]and Google removed Xenu.net from its search engine index[116] Although Google later restored the site after protest by the online community,[117] Other such requests can be viewed at Chillingeffects.org (now Lumen),[118] which documents current efforts to remove content from the Internet. Evidenced by the above projects, censored content, and broken links, if a sustainable model for access and preservation cannot be developed, only a skeletal record will exist of surface content that once was, and is likely no longer available.

Loss of Cultural Memory

Presently, it is empirically evident that the limitations of technology cannot handle the entropy of the network. Initial signs of network connection deterioration are already observable:

- Resource displacement and information escalation due to limitations in storage space and budgetary constraints.
- Collection gaps and network connection caused by increasing inflation rates and limited library budgets.
- Incompatibility affecting the network through divergent access standards, proprietary technologies, format change, and copyright restrictions (access entropy).
- Preservation disconnection among multiple organizations.
- Poor preservation standards and practices of omitting information (incomplete copies) and failure to render formats matching the original context (context distortion).

These conditions are headed in the direction of:

- The decay or collapse of preservation organizations from disconnection, proprietary systems, and unsustainable funding sources.
- Disintegration of the network connection, in as much that information partners and libraries are only able to contribute at a minimal level, or not at all.
- Loss of access to preserved content and format obsolescence (e.g. Voice of the Shuttle, My History is America's History, The Domesday Book, GeoCities, etc.).
- Information loss and destruction of cultural memory.

If not acted upon, entropy will generate pockets of information loss as occurred in the past, but on a potentially larger scale. The stability of format logically predicts that the order of loss will be as follows:

1. Vulnerable physical media: video cassette tapes, audio cassettes, slides, film, photographs, floppy disks, LP's, etc.[119]
2. Proprietary or neglected electronic resources composed of obsolete formats.
3. Unsustainable digital humanities and website content.
4. Non-marketable commercial content in private storage.
5. Profitable commercial content in private storage.
6. Resources stored in non-profit preservation systems.
7. Print materials, microform, and Special Collections print materials.

As the information environment destabilizes through unsustainable methods, the increasing rate of resource displacement, information escalation, and access and preservation unsustainability is leading toward a state of entropy that cannot be overcome…when this occurs, the deterioration of the network connection, and inevitably the loss cultural memory is an increasingly probable situation.

Conclusion

While it is fully comprehended that such an examination of the network connection cannot serve as a panacea for all issues presented, it is hoped that this theoretical paper can function as an avenue of rethinking our present practices, and initiating conversations to engender more sustainable practices among information organizations. As one individual cannot explicate upon every condition concerning humanities access and preservation, participation is vital. Scholars are freely encouraged to debate the content presented. Whereas some analyses and solutions may prove tenable, others may elicit the need for further exploration – collective expertise of the library and information sciences field is requested to untangle the twists and knots in the network connection.

It is suggested that many of the pitfalls plaguing previously failed models include poor infrastructure, ambiguous vision or outcomes, project manager turnover, and unsustainable funding. Such problems must be addressed to successfully integrate digital humanities within the network connection. Sustainable practices are crucial for the continued production, access, and preservation of humanities resources.

In its present state, entropy is rising beyond a manageable threshold in the network connection. Multiple variables operating in parallel (resources, access models, standards, and preservation), existing in various degrees of compatibility, are leaving resources vulnerable to decay and loss. In the network system, individual library budgets cuts cannot afford to perpetuate and subsidize this model of capricious access and preserved content.

It is recommended that libraries and information organizations can reduce entropy on the local and consortia level. Local initiatives, such as refusing non-disclosure agreements, supporting open access mandates, and pressuring vendors to adopt compatible access standards and index sharing can proliferate into larger programs. Demonstrated victories at the local level can serve as persuasive rationale for the creation of consortia to defend library interests at-large.

It is proposed that the development of three consortia: (1) legislative, (2) access, and (3) preservation. In lieu of investing in exorbitant labor costs to address problems at the institutional level, through the minimal financial backing of many participants, efficacious and cost-effective consortia could be developed, as highly influential organizations to defend library interests. Such consortia could also consolidate current organizations and standardize access models to reduce entropy of the network connection. The consortia should strategically focus on the following initiatives to produce the most benefit for libraries and information organizations.

While it is possible that data can be recovered, it is only recoverable if it can be located. Omitted content in the scanning process, non-indexed data, and ephemeral digital humanities and web projects are highly susceptible to data loss. In the event data can be recovered, it may not be accessible in a context that is relevant to scholarly interpretation. Therefore, it is also necessary to practice better methods of preservation, to render exact copies (to the best of our ability) of objects and texts to maintain contextual integrity and prevent format distortion.

In the network connection model, rapidly increasing entropy and unsustainable preservation raises an alarm that demands immediate attention. As it was so famously stated by Paul Courant, with regard to writing, "If we can't retrieve what you have learned, you have violated your scholarly oath."[120] As information professionals, if we cannot provide access, organization, and preservation of information, we have violated our professional oath. It is within this context that information professionals must address this oversight, and find ways to collaborate and develop sustainable processes for production, access, and preservation. If we fail to ignore our duty, the loss of cultural memory in the humanities is a grave possibility.

As a final thought, this article makes an appeal to fellow professionals and information organizations to address the crisis at hand. As the humanities gives us the "opportunity to feel a sense of connection to those who have come before us, as well as to our contemporaries,"[121] let us be certain that we are making the best possible effort to sustainably and contextually offer this opportunity for future generations. The extent in which we respond will determine how much or how little that data loss will be.

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