Research and Recommendation Report
Long-term Maintenance and Preservation of Born-Digital Scholarship

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Introduction

The purpose of this research report is to explore the opportunities and challenges of preserving the born-digital research produced by the Ryerson Centre for Digital Humanities (CDH) through support from Ryerson University Library and Archives (RULA). This report will introduce and investigate the main issues involved in this undertaking. This will include a brief introduction to digital scholarship and the issues involved in its long-term maintenance and preservation, a discussion of current models for library support, and a series of best practices and recommendations for a CDH and RULA collaboration.

Background: Digital Scholarship in the Humanities and Social Sciences

Definitions of digital scholarship range from very broad, as "the use of digital evidence and method, digital authoring, digital publishing, digital curation and preservation, and digital use and reuse of scholarship" (Rumsey, 2011) to the more specific or practice-based, described as "wiki or blog sites, digital archives, online exhibits" as well as mapping tools, databases, and software (Tzoc, 2016, p. 126). The unique features of humanities digital scholarship have been categorized by Julia Flanders and Trevor Muñoz (n.d.) as "scholarly editions, text corpora, text with markup, thematic research collections, and data with accompanying analysis or annotation." New digital research methods and outputs allow scholars to develop computational programs that "recognize, retrieve, and visualize data in meaningful ways" (Sabharwal, 2015, p. 21). The academic rigour found in traditional published scholarship can also be achieved through digital scholarship methods which arise within a "community of editorial practice" (Flanders and Muñoz, n.d.) and undergo academic peer-review (Wisnicki, 2016).

The value of digital scholarship has been shown through the increase in acceptance for and participation in this type of research in the past decade (Siemens, 2013, p. 17; Maron and Pickle, 2014, p. 2). Digital scholarship units in institutions have also shown their value as a way to secure grants and high quality talent, as well as a way to fund and train graduate students (Clement and Reside, 2011). Ryerson's Centre for Digital Humanities (CDH) defines its digital research through "the iterative process of designing online environments for the preservation, visualization, and analysis of cultural texts and histories" (CDH, 2017). The CDH's born-digital scholarship takes the form of "experimental research" in "augmented online editions and critical curation, interactive archives and community-based knowledge production, digital lives and histories, and data visualization and analysis" (CDH, 2017). The *Yellow Nineties Online,* for example, an "open-access, peer-reviewed electronic resource" that publishes facsimile editions of aesthetic, avant-garde periodicals," each with a scholarly introduction, an archive of contemporary paratextual materials, biographies of contributors authored by experts in the field, and "self-reflexive essays" on the research process (CDH, 2017), is internationally acclaimed as a model of public humanities scholarship (Wisnicki, 2016) and is used by researchers, teachers, students, and interested citizens around the world (Hughes, 2012; Mahoney & Abrams, 2015). Funded almost continuously (2011-2021) by the Social Sciences and Humanities Research Council of Canada (SSHRC), *The Yellow Nineties Online* has trained students in digital humanities research practices and innovative scholarly practices for the twenty-first century, many of whom have leveraged this training for

access to doctoral programs, academic positions, librarianships, and positions in digital design and publishing.

CDH-sponsored projects such as *The Yellow Nineties Online* raise Ryerson's research reputation in two key areas of the university's SRC agenda: "digital media and technology" and "teaching and learning for the new economy" (OVPRI).The digital scholarship at the CDH contributes to the university's "commitment to accessibility, lifelong learning, and involvement in the broader community" (Ryerson University Mission, 2017) through the innovative "advancement of applied knowledge and research to meet societal need." More specifically, the CDH contributes to the Ryerson University Library and Archives mission of enabling knowledge creation and providing access to essential information resources. In keeping with the academic plan, *Our Time to Lead*, the CDH and RULA collaboration enables "greater student engagement and success through exceptional experiences" and "increases SRC (Scholarly, Research, and Creative) excellence, intensity, and impact (PVPA).

I. The Long-term Maintenance and Preservation of Digital Scholarship

Introduction and Challenges

Digital scholarship's innovative processes of creation and dissemination are transforming traditional routes of research production and publication (Rumsey, 2011, p.5). Increasingly, the traditional forms of humanities and social science research, journal articles and books, are joined by new digital forms such as interactive online resources, networked communities of software and tools, and research data available in formats that allow for computational analysis and reuse. These changes are also affecting how research will be maintained and made accessible for the long term. Although common formats and standards are emerging, born-digital research objects are highly variable and heterogeneous, usually composed of a combination of digital objects such as text, image and sound files, metadata with item and collection level description, source code which contains instructions for how the data was produced, and documentation of rights and permissions, research motivations, and interpretive frameworks (Flanders and Muñoz, n.d.; Padilla, 2016). For example, a "thematic research collection" and digital scholarly edition such as the *Yellow Nineties Online* is "a highly structured aggregation of XML data" and text and image files, developed through interpretive editorial schemas, and made accessible by a customized functionality layer made up of source code and database software, all of which should be operational for meaningful use of the resource (Sabharwal, 2015, p. 22).

Digital scholarship, including "digitally reformatted texts" (Sabharwal, 2015, p. 22), is complex and valuable for its re-use properties. These characteristics must be maintained throughout preservation. The interlinked and heterogeneous nature of born-digital scholarship in the humanities and social sciences poses challenges to its preservation and future access (Kálmán, Tonne, & Schmitt, 2015, p. 124). The key challenges are as follows:

- Storage media (such as hard drives, disks, or cloud storage) where digital materials "physically reside can fail or become out-of-date and unusable."
- Software and tools necessary to perform or access digital materials can become obsolete.
- Digital media is made of bits that are subject to degradation over time, causing a digital file to become corrupt and unusable.
- Loss of files due to human error, malevolence, or natural disaster.
- Loss of meaning and context due to lack of description or metadata.
  (adapted from Schumacher et al., 2014, p. 3)
- Loss of funding required to ensure against all of the above

These challenges may be mitigated by preservation strategies that maintain access not only to born-digital research objects but also to the tools or code with which they are created/accessed and information about their origins, use or processing, method of publication or presentation, and the motivations which led to their creation and use. Such strategies also aim to identify user groups for which born-digital research would have the greatest value. Successful maintenance and preservation of born-digital scholarship combines three levels of activities: bit preservation, which "ensures that the bit streams of a file are not altered," and the more complex "content preservation and data curation [which aim] to provide long-term readability and long-term interoperability"

(Kálmán, Tonne, & Schmitt, 2015, p. 125). Examples of digital preservation activities may include documenting the questions, motivations, and processes in the creation and use of digital objects, migrating digital files to more reliable file formats, capturing static images of web sites over time to track changes, and/or storing files in a digital repository with preservation management.

Planning and Strategies for Preservation

Research in effective strategies for the maintenance and preservation of digital scholarship is still a growing field, but progress has been made in the last decade (Kilbride, 2016). A common model used in the management of digital materials is the **lifecycle model** developed by the Digital Curation Centre (DCC). The model acknowledges that digital material is "susceptible to technological change from the moment of creation" and "ensures that all the required stages" in the lives of digital objects are "identified and planned" (Higgins, 2008 p. 135). Accordingly, **preservation concerns should be part of initial project planning**. The goal of the approach is the "maintenance of authenticity, reliability, integrity, and usability of digital material" (p. 135). The DCC model defines data (as simple or complex digital objects and databases) and outlines the curation actions that should be taken according to each life stage, throughout the lifecycle, and occasionally (p. 137).

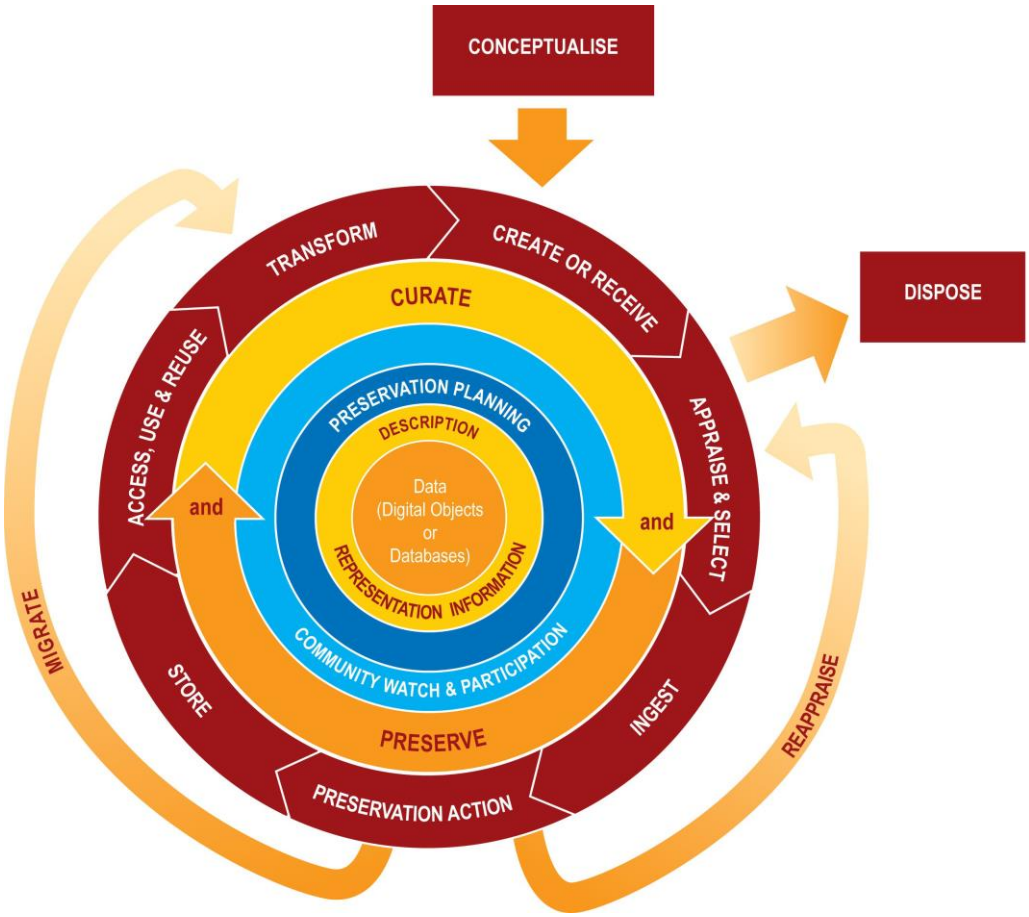

Figure 1: The DCC Curation Lifecycle Model

Reviewing the lifecycle model, it becomes clear that the maintenance and preservation of digital objects is an "incremental, ongoing and ever-shifting set of actions, reactions, workflows, and policies" rather than an "either/or proposition" (Schumacher et al., 2014, p. 5). Those committed to digital preservation will need to "embrace change" and maintain "close contact with emerging trends and solutions" (Kilbride, 2016, p. 484). Although the ongoing nature of digital preservation may be daunting, it also suggests that "small steps" may still be taken in a positive direction when resources and skill sets are limited (Schumacher et al., 2014, p. 5). The small step incremental approach is recommended by the members of the Digital POWRR team (Preserving Digital Objects with Restricted Resources) who have researched effective methods for raising awareness, developing, and adopting digital preservation strategies in "small and mid-sized institutions" with limited resources (Schumacher et al., 2014). The POWRR team identifies the National Data Security Alliance (NSDA) Levels of Preservation guideline (see Appendix A) as a simple and concise reference document for developing or improving a digital preservation plan. The NSDA guide is "organized into five functional areas that are at the heart of digital preservation systems: storage and geographic location, file fixity and data integrity, information security, metadata, and file formats" and allows institutions to assess the current status of their preservation program and improve it gradually by moving up through the levels, from Protect to Repair (NSDA, 2013).

Data Management Plans

Alongside models for preservation planning, the creation of a Data Management Plan before commencing a research project has also become a common, and sometimes required, practice for grant applications (Lynch, 2014). Creating a data management plan allows researchers to choose sustainable methods that will help them in the long-term, anticipate and plan for any obstacles that may occur during their work, and set manageable expectations for the future accessibility of their research. Data management plans "typically state what data will be created and how, and outline the plans for sharing and preservation, noting what is appropriate given the nature of the data and any restrictions that may need to be applied" (DCC, 2017). A data management plan may set out which formats and software a project will use, where the data will be stored before and after project completion, and, if possible, how the data will be disseminated for review and reuse. It should also specify how data management costs will be funded and for how long before and after project completion. See Appendix B for a list of resource and tools for creating data management plans.

Assessing Needs and Expectations

One of the most important questions for digital preservation is to ask *who* will be using the research data in the future and *how* will they be using it. The proper management and preservation of digital materials depends on a thorough understanding of these issues. Referring to the DCC Curation lifecycle model, the "Conceptualization" stage should involve a discussion of the needs and expectation of all project stakeholders (Sabharwal, 2015, p. 98). This may require identifying and opening a dialogue with user communities, in the form of interviews or user surveys. One method of gathering this type of information is through the use of "preservation intent" statements (Web, Pearson, & Koerben, 2013). Submitted by researchers, collection curators, and/or preservation specialists associated with a project, preservation intents are "explicit statements about which collection materials…need to remain accessible for an extended period, and…what 'accessible'

means by stating the priority elements that need to be re-presented in any future access for each kind of digital object" (Web, Pearson, & Koerben, 2013). This process can help draw out and manage differences of perspective during the conceptualization process.

A related concept to be considered at this stage is "significant properties"; these are the "characteristics of digital objects that must be preserved over time in order to ensure the continued accessibility, usability, and meaning of the objects, and their capacity to be accepted as evidence of what they purport to record" (Wilson, 2008). At the conceptualization stage a list of significant properties or characteristics of the collection should be identified. For example, a significant property of the *Yellow Nineties Online* may be the ability to view the primary source material in all available formats (pdf, flip book, html and xml) and, as such, this feature should be maintained throughout preservation activities. Inevitably, decisions about significant properties are intricately linked to the needs and expectations of the user community and must be conceptualized together. The above methods for planning and assessing can also be used for projects or collections that are already underway or complete. In these situations, planning may include content profiling which surveys and describes the digital objects currently in the collection (Day et al., 2014).

Preserving Specific Types of Digital Objects

Due to the heterogeneous nature of born-digital scholarship, there is no one preservation strategy that fits all types of digital materials. Standards, specific tools, and best practices have been developed for common file types, such as text and image files, websites, etc. In most cases, best practices favour open source or interoperable formats and software and discourage proprietary formats. See Appendix B for a list of preservation resources for different types of digital objects.

Storage, Repository Services, and Responsible Data Curation

Storage is an important part of any preservation plan. Storage services may be provided within the institution, on the shared university or library server or externally by a cloud storage service. A broad group of stakeholders, including scholars, librarians, archivists and computer scientists, have developed internationally-recognized criteria for identifying a trusted digital repository (Dale & Ambacher, 2007). The extensive criteria checklist, known as Trusted Repository Audit & Certification (TRAC), is organized into three sections:

- Organizational infrastructure, which affects "performance, accountability, and sustainability" (Dale & Ambacher, p. 9)
- Digital object management, which includes "repository functions, processes, and procedures needed to ingest, manage, and provide access to digital objects for the long term" (Dale & Ambacher, p. 21)
- Technologies, technical infrastructure, and security, which "describe best practices for data management and security" (Dale & Ambacher, p. 43)

Trusted repositories do not simply store data securely, but also enlist or form a series of tools and activities that ensure that all levels of a digital object are preserved, from the bits to the contextual information that makes the objects usable. This entails regular fixity checks and repairs, geo-differentiation, migration to new file formats when/if necessary, and the creation of

representational metadata that "accretes through time," tracking preservation activities (Kilbride, 2016, p. 485).

Access and Reuse

One of the most innovative and valuable aspects of digital scholarship projects is the ability to build a space for community interaction. Once a project's output is moved to a digital repository, the digital materials may be accessible, but some of the significant properties of the project may be lost. A further danger of this scenario is that without the engagement of the community, preserved digital collections "run the risk of creating digital mortuaries" where static data loses its significance without use (Kunda and Anderson-Wilk, 2011, p. 896). Preservation programs must keep the issue of meaningful access at the forefront, making data curation an important consideration. Models for preservation that build on the lifecycle model in regards to access and community engagement include the Stories and Stewardship Digital Curation model (Kunda and Anderson-Wilk, 2011) and the SCU Digital Curation Process Model (Dallas, 2016).

Finally, whether a repository, website design, or another form of technology, the technical interfaces through which digital scholarship is engaged inevitably have an effect on its production, dissemination and interpretation. One of the aims of digital scholarship is to investigate the interpretive frames of technology as a "mediating actor" (Ruecker, 2016, p. 470). Underwriting all preservation and access work should be a similar consideration of how "the affordances of digital tools and services—databases, repositories, digital libraries, multimedia platforms, mobile devices, digital capture equipment, etc.—have a major effect on enabling and constraining curation activity" (Dallas, 2016, p. 446). The "digital tools and services" of preservation

> act in tandem with procedures, methods, and normative arrangements that co-determine practice, as part of sociotechnical infrastructures whose full semantics cannot be subsumed in their formal description, as it also entails tacit understandings that are introduced, tweaked, and shared by specific communities of practice. (Dallas, 2016, p. 446)

Engaging user communities during program and system conceptualization, "design, and deployment" can help to create positive knowledge mobilization and meaningful outcomes (Dallas, 2016, p. 447).

Funding

Underwriting all preservation plans must be a way to ensure that funds are available for necessary maintenance activities. Ideally, initial project plans would include a portion of the budget that could cover the hosting and preservation of a project for a desired amount of time; however, "knowing, expressing, and modelling the underlying costs of digital preservation has proven tricky" (Kilbride, 2016 p. 486). Preservation of digital scholarship can be especially difficult because much of the research is funded through grants that have inevitable end points (Zorich, 2008; Brown et al. 2009; Nowviskie, 2010; Maron and Pickle, 2014). Without institutional support, digital scholarship teams lacking the continuation of grant funds have explored alternative funding routes. Susan Brown et al. (2009) notes that one barrier for continued funding of digital scholarship is the perception of a project not being "done" until it is published; conventional ideas

of publication do not apply to these new types of research output (p. 18). Brown et al. suggests an appropriate model for publishing digital scholarship may be one similar to online journals "for whom 'done' can be applied to particular issues but not to the relevant research area" (Brown et al., 2009, p. 20). The analogy is a good starting point; however, the standardized format of online articles makes them much easier to manage than the amorphous digital scholarship project. In Brown's case, her *Orlando Project* secured partial sustainability by licensing the textbase to a scholarly press, which now charges subscription fees to access part of the content (Brown et al., 2009, p. 19). The model of scholarly publishing and subscription has also been used by others, such as the *Samuel Beckett Digital Manuscript Project*, *British History Online*, and the numerous digital editions hosted by Rotunda from the University of Virginia Press. In some cases the bulk of the resource is available open access while premium full-access subscription fees cover maintenance costs, which may be an important consideration for scholars dedicated to openly providing their research to the public. Other forms of monetization used by digital scholarship teams include: crowdfunding, which engages the user community but is unreliable for long-term stability; selling online ad space; "commercialized spin-offs"; and "consultancy and services," such as providing skills, hardware and tools for a fee (Kelly & Sichani, 2016).

The problem of preserving digital scholarship for the long-term is complex but the solutions developed now will impact the future of scholarship in a major way. It is also not solely the problem of researchers to solve but will require the collaboration of institutions and a wider network of innovators and stakeholders (Cantara, 2006).

II. Library Services and Collaboration in Digital Scholarship Preservation

Libraries, Preservation, and Digital Scholarship

Several surveys and studies of the last decade have shown the natural overlap in digital scholarship in the work of librarians and faculty researchers, as well as the increasing collaboration that is occurring between these two groups. (Cantara, 2006; Bryson et al., 2011; Sula, 2013; Corrall, 2014; Mulligan, 2016). Libraries are key collaborators in digital scholarship due to their subject knowledge, technical expertise in managing and curating information, goals for preservation and open access, and mandate in "uniting diverse disciplines" (Alexander et al., 2014). Libraries and digital research teams also face the same opportunities and challenges of working in an innovative and constantly changing field (Vandegrift and Varner, 2013). As the goals of the research community shift towards experimentation, digital methods, and open access, the role of the research librarian also expands "to encompass the broadening scope of scholarship" (Vandegrift and Varner, 2013, p. 68). An MIT institute-wide task force on the future of the libraries positions the research library as leader in the "long-term stewardship and sustainability of the scholarly record" which requires the library to understand its users as not only "direct readers" but also "content contributors" and "community curators" (MIT Task Force, 2016, p. 6).

The library's opportunity for impact and innovation is great, but the responsibility is also great, and one that challenges some of the time-honoured roles of the library. As the nature of scholarship and research shifts in response to digital resources, tools, and networks, and new expectations for access, libraries face the dilemma of deciding between traditional analog costs and new expenditures associated with digital preservation (Conway, 2010, p. 70). Libraries are changing to meet users online in a way that "supports a wide variety of actual and potential uses," and in the transition they are positioned to create "lasting value—value that is embedded in the digital collections themselves rather than primarily derived from their association with original source material" (Conway 2010, p. 74). The next section of this report will examine needs and expectations for support, address some of the challenges library collaborations in digital scholarship may face, and give an overview of organizational approaches and service models that libraries have developed to respond to the new role effectively.

Current Faculty and Researcher Feedback on Digital Practices and Library Support

Recent survey results give some insight into the researcher needs and expectations for library support in preservation. Released on Oct 4, 2016, the Canadian Association of Research Libraries (CARL) faculty survey report gives an overview of the results of local faculty surveys administered since 2014 at eleven member institutions in CARL, including Ryerson (Wolff, 2016). The survey included a "core set of questions on preferences and practices related to discovery, digital research activities, perceptions of student research skills, the role of the library, and data preservation and management" (Wolff, 2016, p. 4). Most researchers, especially those who have less than 5 years in the field, are "very interested in integrating digital research activities and methodologies" (p. 19) into their work. 81% of Ryerson faculty respondents said that the library's role "as a repository of resources… [in that] it archives, preserves, and keeps track of resources"

was "very important," second only to that of providing resources (p. 29). Across all institutions, Arts and Humanities faculty are more likely to build up more diverse collections of digital materials than respondents from other disciplines and the ability to update existing datasets was the most highly valued feature for data management (p. 33). Additionally, "faculty members have a clear preference for self-reliance in preserving their research data following the conclusion of a project" (p. 33) although a close second most valuable source of support in this area was the library (p. 39-40). Currently, preservation is being overwhelming done by faculty on an individual basis as opposed to using services provided by the library or institutional repository (p. 41).

A separate survey of fourteen self-selected Ryerson Arts faculty gives some specific insight into the born-digital scholarship practices and preservation needs of this community. When asked about the type of born-digital materials they were using in their work, 85 % of the respondents reported using eBooks, online reference works, and digital text, image and/or audio-visual files. Blogs, websites were the second-most used at 78% and digital archives and online editions were used by 64% of respondents. Most respondents (71%) see their digital material as having value beyond their own use, especially to students and other researchers in their discipline, although sharing their work was not a required condition of receiving grant funding. Currently, half the respondents were making their material accessible to others in some way. Practices for preserving and sharing born-digital materials were varied, with some researchers using cloud storage and/or back up hard drives to store materials, some sharing through personal, academic, or resource-specific websites, some relying on publishers for preservation and dissemination, and some not actively engaged in preservation or dissemination. The most pressing preservation concern was the loss of digital content due to hardware/software malfunction (85% identified this as a challenge), with loss of access due to obsolescence or incompatibility a close second (78%). Issues of broken web links and with rights/permissions were also major concerns for 71% of respondents. When asked what library services they would find beneficial for dealing with these issues, 64% respondents felt that developing best practices or guidelines for born-digital preservation would be helpful to them, and 57% were also interested in repository services and individual consultations. 50% of respondents felt a subject guide to digital scholarship would benefit them, and 42% identified workshops and research project collaboration as other helpful possibilities. Overall the respondents noted that they believed the issue of preservation was a significant one and felt it was a place where "librarians and scholars should be working together."

Challenges in Library Collaboration in Digital Scholarship

Through institutional surveys and case studies of current programs, researchers have identified some key challenges that arise when library and faculty work together on digital scholarship projects.

The research/service divide:

Due to the nature of digital scholarship projects in merging innovative techniques with inquiry, the traditional roles of faculty as researcher and librarian as service provider also become blurred. Generally, it is acknowledged that faculty feel freer to experiment and take risks, while the library's focus is on developing sustainable tools and systems that may be used more broadly

across its user base (Vinopal and McCormick, 2013; Posner, 2013; Nowviskie, 2013; Maron and Pickle, 2014). Although some report feelings of competition, generally faculty welcome librarians to participate as research collaborators, but those working in the library do not have the training, resources or flexibility—the "time and space"—required (Nowviskie, 2013; Posner, 2013; Keener, 2015, p. 38). Miriam Posner (2013) relates this issue partly to a lack of institutional incentive: a preservation project "means more headaches down the road (about upgrades and server space and support) for the librarian, while "professional payoff" for faculty (although not "all it should be") is more clear (p. 48).

Centralization vs. distributed approaches:

Another challenge cited by researchers is that the call for distributed approaches—models that encourage building a network of support and service as a way of diluting risk and spreading resources both within the institution and beyond—are not always balanced with clear lines of communication, direction, and ownership (Maron and Pickle, 2014, Vinopal and McCormick, 2013; Tzoc, 2016). Innovative and collaborative approaches may have positive initial results; however, a lack of clarity on an "exit strategy" can lead to misunderstandings and projects falling through the cracks (Posner, 2013; Maron and Pickle 2014, p. 40).

The ongoing nature of digital scholarship preservation:

Related to the need for an exit plan, the reality of digital scholarship is that there is not likely to be a time when projects can actually be considered finished or preserved (Tzoc, 2016; Kilbride, 2016). Ongoing digital preservation is more akin to data curation than traditional preservation and the consequence of this is an unnatural fit for librarians who are accustomed to completion (Nowviskie, 2013, p. 59). This challenge is related to a similar challenge inherent in the uniqueness of digital scholarship projects: services for digital scholarship are hard to develop as these projects do not fit in with larger digital library initiatives such as mass digitization programs or modern scholarly journal publishing (Harkema and Nelson, 2013; Tzoc, 2016).

Current Models for Digital Scholarship and Preservation Support

Organizational Approaches

Support for digital scholarship can be provided in the library in a number of ways. The Ithaka S+R study "Sustaining the Digital Humanities: Host Institutional Support Beyond the Start-Up Phase" outlines three models for support: **the service model, the lab model and the network model** (Maron and Pickle, 2014).

The **Service model** manifests as a permanent unit that operates within the library and supports digital scholarship. The service model aims to "meet the demand expressed by faculty, often with a strong focus on meeting an individual's research needs" (Maron and Pickle, 2014, p. 23). This service unit may be part of a larger digital initiative or scholarly communication team. In the service model approach, this unit may provide assistance to faculty through training and/or consultation in project planning, standards and platform knowledge and content preservation (p. 24). Technical capabilities within the service model are focused on sustainable solutions that can be used broadly rather than experimental or customized tools; however, a tiered service model can

help to accommodate diverse needs (Vinopal and McCormick, 2013; Maron and Pickle, 2014; Tzoc, 2016). Service unit staff may also facilitate server or storage space for digital projects or coordinate with other service providers on campus or externally (Maron and Pickle, 2014, p. 29-30). The individuals providing support in the service model are usually seen as support staff and not research collaborators and their time devoted to digital scholarship is often balanced with other library service requirements (p. 25).

In the **Lab model** approach, a centre or lab within the institution (possibly within a faculty department or in the library) serves as a host site for digital scholarship projects and oversees their development and maintenance. Labs or centres have a "specific focus, tied either to the mission or to the aims of their founders" (Maron and Pickle, 2014, p. 31). A lab, depending on its size, usually combines faculty, librarians, permanent or grant-funded staff such as project managers or programmers (p. 31). With free range over research projects, this model allows for creativity, experimentation and innovation as well as focus and control. The lab model has received a lot attention among the digital scholarship community; however, the intense focus of a lab may mean it is limited to specific individuals or disciplines (p. 32). Another drawback of the lab approach may be that its strength in innovation and experimentation sometimes comes at the cost of its ability to sustain projects in the long term (p. 32).

The third model identified by Maron and Pickle (2014) is the **Network model**, which is an attempt to connect diverse units related to digital scholarship across an institution, such as the library, research labs, and IT services. In this model, services and research focuses would have evolved independently over time, and then become linked through shared interests and needs (p. 34). The decentralized approach has its strength in combining multiple partners and skill sets but needs strong direction to cohere, as well as clear service pathways (p. 34). There is a risk in this model of the separate units becoming siloed or even competitors (p. 39). The authors also stress the need for an exit plan for digital projects, requiring that one unit must officially take ownership of projects to ensure they are sustained (p. 40).

Incremental and Experimental Service Development

As the three models listed above indicate, there is no tried and true method of service or program provision that will fit the preservation needs of all institutions. Surveys have shown that digital preservation is one of the main technical skill gaps in library services (Mulligan, 2016, p. 8), suggesting that these services are still malleable and ripe for development and innovation. It is important to understand user community needs and develop support systems that are well-suited to the local institution (Sula, 2013). Successful and sustainable program development has been achieved through incremental, ad-hoc and/or experimental staffing approaches (Vinopal and McCormick, 2013; Nowviskie, 2013, Vandegrift and Varner, 2013; Tzoc, 2016). New models also breakdown outdated boundaries between research and service roles, develop communities of practice and "embrace an iterative process" to "learn by doing and for the purpose of modeling and socializing new forms" (Rumsey, 2011, p. 23). Often, digital scholarship collaborations in the library will aim to revitalize traditional roles; this is achieved through the creation of hybrid positions, or "strange institutions" that combine librarians, researchers and tech specialists (Rumsey, 2011, p. 23; Kimball, 2011; Vandergrift, 2013; Nowviskie, 2013; Fay and Nyhan, 2015).

Incremental or experimental service provision develops as current positions in the library are either expanded or re-skilled to support digital scholarship (Fay and Nyhan, 2015). Vinopal and McCormick (2013) suggest one model of an incremental approach is to "identify current staff who are best situated (because of knowledge and skills) to help develop digital services, then free them up to lead the initiative" (p. 37). An informal survey of digital scholarship research services in North American research libraries reveals several current positons that have proved equipped to provide this support. Current approaches include:

- Digital Initiatives/Scholarship Librarian: A liaison librarian within the library or the library IT team, skilled to facilitate digital scholarship though collaboration, consultation, and the provision of technical advice and/or services. This role is generally focused on digital humanities/scholarship, rather than other types of digital research data, and preservation is one aspect of their work
- Faculty/Research Unit Embedded Librarian: Bringing subject and technical expertise and housed within the faculty research team, the embedded librarian may serve as project partner, advisor, or manager on digital scholarship projects.
- Digital Preservation Librarian: A librarian or IT specialist, housed within the library or library IT services, who would provide preservation services for digital scholarship as part of their overall preservation focus.
- Scholarly Communication/Research Support Librarian: A librarian skilled in facilitating faculty research output though services such as open access education, repository management, and/or support for research methodology and tools. Preservation of digital scholarship would be one aspect of their work.
- Special Collections Librarian: A librarian working in rare books and/or archives units who would facilitate digital projects with these collections, providing field expertise on digital preservation among other aspects.
- Subject Liaison Librarian: A subject-specialist who would provide discipline specific digital scholarship preservation services/advice to their assigned subject strengths.
- Metadata Librarians and Electronic Resources Librarians may also have suitable skill overlap to provide preservation services for digital scholarship.

Library Preservation Services for Digital Scholarship

As digital scholarship has emerged as a new focus for libraries, a number of service modes have evolved to meet the diverse needs and expectations of researchers. Below is an overview of current services:

Consultations: Using the form of the traditional reference consultation, researchers may seek out one-on-one interviews with the digital specialist to receive advice on the methods suitable for their project. Consultation services would serve as one gateway to other library resources, such as subject guides, workshops, and available tools or platforms for research. The consultation may also lead to more formal support based on the services available.

Workshops and training: These may include one-off or regular training opportunities in using digital tools, best practices, standards, and methods in research and preservation. Workshops may be hosted in the library, in the classroom for course-specific sessions, or online.

Subject guide to digital scholarship/preservation: In the traditional library research guide format, the digital scholarship preservation libguide provides quick reference information on the subject and compiles a list of library and other resources. The guide would also identify routes and contact for related library services.

Technical services: This service or group of services facilitates file storage and/or server space for researcher projects, access to software, tools and platforms (such as Omeka, Wordpress, etc), and/or hardware such as digitization suites. This set of services could range from standardized formats and basic storage options that would serve a broad spectrum of users, to more advance or customized tools and repository services that would require more staff time and support.

Work spaces: This service provides collaboration space for researchers to use for their work or meetings; it may also include spaces with technology for digitization and digital media labs. The spaces may be permanently dedicated to digital scholarship or multi-use.

Staff project support: A more ad-hoc service that would arise out of consultations and technical services, staff project support provides researchers with library staff time and skill support to address specific project needs. This may include support in the creation of data management plans or customized technical support such as programming or repository services.

Project collaboration: An enhanced level of project support, this service would provide the time and space for research partnerships to occur between librarians and researchers. Support may be through research project input and design, significant technical support, etc.

Research and Development: This research-focused activity, led by librarians and/or faculty, would be "aimed at developing methods and infrastructure with possible (but not certain) future research value… leading to reusable products or integration among existing tools" (Vinopal and McCormick, 2013, p. 33).

Coordination and Synchronization: This service places librarians in the centre of a network of external support services available to the researcher, such as institutional IT services, consortium services or recommended commercial vendors who specialise in areas such as storage and server space, user experience, repository services etc. The library recommends suitable external partners or acts as a liaison, perhaps facilitating the connection through accounts with the external provider, etc.

Advocacy and Awareness: This role would see the library as an advocate for digital preservation through outreach on social media, hosting conferences and events, etc.

Tiered Services and Service Rationalization

The range of services provided across institutions represents the different strategies used to overcome some of the main challenges in library services, including the need to balance sustainable solutions with innovative projects. One solution is to offer support through a tiered

model, which acknowledges "their existing and desired services as a spectrum of methods for supporting digital scholarship"; these range from easy to use tools that are broadly applicable, such as platforms for blogging or creating online exhibits, to those that require "experimental, resource-intensive initiatives" (Vinopal and McCormick, 2013, p. 33; Maron and Pickle, 2014). Through tiers, the majority of users are able to access support through standardized sustainable services that have low impact on staff, and users who need customized help that requires more staff time would be able to access those services through specified routes. Vinopal and McCormick (2013) note that:

> services requiring more staff time and support will be necessarily selective and a well defined selection process is required to manage demand. Selection processes for these services will vary from institution to institution; criteria can range from focusing on VIP faculty, to partnering with a particular department or program, only accepting projects that come with grant funding, or offering funds for which scholars may compete. (p. 33)

The parameters of rationalized service models would be set out in library policies and communicated in a clear manner to users. The communication of roles and responsibilities in all collaboration cases is very significant for the success of the partnership; many case studies support the use of service agreements or contracts for projects that will engage library staff at anything higher than the basic service level (Zorich, 2008; Vinopal and McCormick, 2013; Maron and Pickle, 2014).

Funding Digital Scholarship Preservation through Library Services

Collaborating with libraries has been identified as one key way researchers can get more stable funding for the preservation of their work (Alexander, 2014; Sinclair, 2014). Libraries' budgets are a permanent source of funding within the institution, while many research projects may rely on grants with set endpoints (Mulligan, 2016; Wong, 2016). That being said, library budgets are overburdened in most cases and money for preservation will necessarily take funds away from other areas. (Posner, 2013; Schumacher et al., 2014, Wong, 2016). As mentioned above, spreading out risk and budget requirements over multiple departments within an institution (for example across select faculty departments and/or administrative units and the library) or across institutions (as in a consortium) is one way of funding new services. The Scholars Portal "Ontario Library Research Cloud" and the Canadian Association of Research Libraries "Portage Preservation Pipeline" digital repositories, both still in development, are examples of this approach. A similar option is the creation of permanent staff positions jointly funded by the faculty and the library and which would support both groups (Clement and Reside, 2011). Similar to the funding alternatives explored by digital scholarship teams, options to fund library services might include monetizing consultancy and technical services, and licensing digital scholarship for subscription fees.

III. Recommendations for a RULA/CDH Preservation Collaboration

Based on the research and current case studies in the field, a RULA/CDH collaboration would be a mutually-beneficial partnership to achieving both groups' goals of providing long-term access to innovative digital research. The remainder of this report will summarize the research in best practices for collaboration, as well as outline a sample project plan for initiating development using *The Yellow Nineties Online* as a case study.

Best Practices in Library Faculty Collaborations to Support Digital Preservation

Taking the above research and case studies into consideration, the following lists best practices for library and faculty collaborations in digital scholarship preservation:

- Embark on collaborations through incremental and exploratory processes but with sustainable and scalable end goals
- Preservation strategies must be customized to the character and requirements of the digital scholarship project; however, efforts should be made to establish standards and programs that can apply more broadly. A tiered service approach which plans on a spectrum of self-sufficiency to rationalized high level support can help to achieve both goals.
- Service development should be based on a user-centred approach and include mechanisms for impact assessment and review.
- Digital preservation is an ongoing task; establish clear timelines for preservation goals and set up appropriate review mechanisms.
- Digital preservation is also a subjective task; establish clear expectations for how a resource will be used and accessed and by whom.
- Build strong preservation networks by developing relationships within the institution and with external partners to leverage skills and technology and dilute risk and resource strain.
- Despite experimentation with traditional boundaries, maintain clear roles and responsibilities through the use of formal agreements or understandings.
- Acknowledge that workloads are at a maximum and obtain support to either free up staff time for service development or increase staffing.
- Review incentive and motivation programs with staff and ensure they are appropriate for what is being asked of them.
- Engage the community through education, advocacy and awareness activities around digital preservation.
- Preservation requires stable funding; develop strategies on obtaining it either through institutional support or alternative monetization approaches

Sample Project Plan

Below is a recommended road map to building a sustainable and successful program:

Phase 1: Incremental and experimental skill and service development
Suggested Timeline: April 2017 – April 2018

- Identify individual(s) with relevant skills and interest in current RULA staff (and/or potentially interested CDH staff) to form the project team. Ideally they would come from related library units (as outlined above) and/or have some knowledge of the issues involved, although this is not a requirement. These individuals/this individual will form the project team, which will have oversight from both RULA and CDH.
- RULA and CDH management should formally acknowledge team members participation and adjust their respective workloads in order to free up time for the project
    - If this staffing scenario is not feasible due to workloads, then a position should be created through the joint funding of the Faculty of Arts and RULA.
- Using the *Yellow Nineties Online* as a case study, working with the primary researchers, and drawing on the research provided in this report, the project team will develop a list of services/activities that would support the long-term preservation of the *Yellow Nineties Online* by achieving these main goals;
    - Understanding the needs/expectations of users and future users (through interviews, preservation statements or identifying significant properties, etc.)
    - Understanding the technical requirements of the project (through collection profiling, a review of format and software sustainability and/or storage and access etc.)
    - Understanding the necessary contextual apparatus (documentation of research methods and workflows, information about original sources, custodial history, metadata schemas, etc.)
    - Understanding the resources available to the project (funding, staff, skills)
    - Based on the knowledge gained from the above, the creation of an appropriate long-term preservation strategy for the resource.
- Based on the list, team members will identify the services/activities that can be undertaken immediately, those that can be accomplished with additional resources, tools and training, and those that need further research and exploration.
- A plan of action for undertaking these services/activities will be drafted based on capacity and set in motion with clear end goals, timelines and documentation/assessment mechanisms in place.

Phase II: Review and Recommendations
Suggested Timeline: April 2018 – June 2018

- Upon completion of Phase I, the project team will create a report and recommendations for a digital scholarship preservation program, to be presented at the RULA and CDH annual general meetings, as well as to the Chief Librarian, the Dean of Arts, and the Provost and Vice President Academic.

- The project team and stakeholders will meet to discuss implementing the recommendations of the project team at a higher institutional level, through the creation of Faculty and RULA policies and procedures, funding plans, and organizational models.

Phase III: Service Planning and Implementation
Suggested Timelines: June 2018 – Fall 2018 (service launch)

- According the Phase I outcomes, and Phase II discussions and planning, RULA services to support the preservation of digital scholarship will be developed in summer 2018 with anticipated service launch in September 2018.

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Appendix A: NSDA Levels of Preservation

Table 1: Version 1 of the Levels of Digital Preservation

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

Appendix B: Select Resources for Digital Preservation in the Arts and Humanities

Tools for Preservation Planning:

Canadian Association of Research Libraries DMP Assistant: https://assistant.portagenetwork.ca/

University of California Digital Library Data Management Tool: https://dmptool.org/

Digital Curation Centre's DMP Online: http://www.dcc.ac.uk/dmponline

Other assessment tools and resources from the DCC: http://www.dcc.ac.uk/resources/tools-and-applications

Creating a Data Curation Profile: http://datacurationprofiles.org/

Resources for Preserving Specific Types of Digital Objects

The *Archaeology Data Service / Digital Antiquity Guides to Good Practice* gives an concise introduction to digital preservation, with chapters on preserving documents and text, databases and spreadsheets, raster images, vector images, and digital video and audio.

http://guides.archaeologydataservice.ac.uk/g2gp/BasCom_Intro

The Library of Congress *Digital Preservation* web page includes links to their format guides, preservation tools and metadata standards (PREMIS):

http://www.loc.gov/preservation/digital/

The Library of Congress *Sustainability of Digital Formats* web page provides information about digital content formats, including information on sustainability factors and specific discussion of a variety of content categories, including images, sound, web archives and datasets:

http://www.digitalpreservation.gov/formats/index.shtml

The UCLA Libguide on *Research Data Management for the Humanities* has useful information for planning, documentation, and file formats:

http://guides.library.ucla.edu/data-management-humanities

The York University *Guide to Research Data Management* provides easy to parse information on metadata, file formats, organizing data, access and preservation:

http://researchguides.library.yorku.ca/content.php?pid=382352&sid=3873543