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Digitizing the Ancestors: Issues in Indigenous Digital Heritage Projects

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Between 2002 and 2007, several university researchers (Christen, Ridington, and Hennessy; Shorter, Srinivasan, Verran, and Christie) collaborated with Indigenous communities to create digital heritage projects. Although the initial build and methodology surrounding the projects are well documented, the current status and end results are not. Now that a decade has passed since their production, this article examines the issues that have arisen with these Indigenous digital heritage projects. The primary emphasis is on sustainability, and the discussion concentrates on outdated software, funding problems, and maintenance issues that have afflicted these projects over the years. This study concludes that researchers need to take sustainability practices into consideration when creating specialized digital heritage projects.

Keywords: digital heritage, virtual exhibition, content management system, sustainability, traditional knowledge, Indigenous, Native American, First Nations, Aboriginal

Indigenous communities with access to information and communications technologies (ICTs) have used digital media to share their tangible and intangible culture and to store their vast bodies of knowledge.[1] With a few clicks, the wisdom of their ancestors can be accessed by the world or by a select few members. Whether this knowledge takes the form of the visual arts, traditional storytelling and songs, repatriated objects, or digital documents, the issues remain the same: What material is being displayed? Who has access? How is the site maintained? University researchers have worked with Indigenous communities in creating digital heritage projects to help address these questions (Christen, 2008; Ridington & Hennessy, 2008; Shorter, 2006; Srinivasan, 2007; Verran & Christie, 2007). Their work is well documented and frequently cited when discussing approaches in Indigenous intellectual technology (Bidwell & Winschiers-Theophilus, 2015; Dyson, Hendriks, & Grant, 2007; Hennessy, 2012; Nakamura & Chow-White, 2012; Nemati, 2008; Srinivasan, 2017). The communities with which they have collaborated, including the Warumungu (Christen) and Yolngu in Australia (Verran and Christie), a consortium of tribal communities in Southern California (Srinivasan), the Yoeme in Mexico and the United States (Shorter), and the Dane-zaa in Canada (Ridington and Hennessy), have all initially benefited from the digital projects that were uniquely tailored to their needs. This is to say that these collaborative projects adhered to local cultural protocols and

[1] The term *Indigenous* is being used here in a global context to refer to peoples who identify as the first inhabitants of a given area. This article also employs the common terms used to describe Indigenous populations in particular regions, such as "Native American" and "American Indian" in the United States, "Aboriginal" in Canada and Australia, and "First Nations" in Canada.

allowed the communities to share traditional knowledge on their own terms. Yet, these databases were all created in the mid-2000s and are now more than a decade old. Existing scholarship discusses the implementation of such Indigenous digital heritage projects (Cameron & Kenderdine, 2007; Colley, 2015; Dyson et al., 2007), but there are no studies that consider the long-term use of these systems. In addition, there has been little published on the Indigenous communities that have created a digital heritage presence without the assistance of a scholar. This article critically examines how Indigenous digital culture is produced and performed through virtual exhibitions and digital archives. I investigate these matters through an analysis of the end product, considering the software, security, and sustainability of these heritage projects.

Method

The specific examples discussed are the Mukurtu Wumpurrarni-kari archive (Christen), Tribal P.E.A.C.E. (Preserving Education and Cultural Expression) website (Srinivasan), Vachiam Eecha: Planting the Seeds virtual exhibition (Shorter), IKRMNA (Indigenous Knowledge and Resource Management in Northern Australia) database (Verran and Christie), and Dane Wajich—Dane-zaa Stories and Songs: Dreamers and the Land virtual exhibition (Ridington and Hennessy). These projects were selected primarily because they are the most cited Indigenous digital heritage cases, and because they all incorporate audiovisual media created and collected in collaboration with the respective Indigenous communities. Although it could be a coincidence that they all originated within two years of each other (2003–2005), I maintain that this represents a larger trend of academic activism, formally known as participatory action research, or "engaged" scholarship—a decolonizing method of "giving back" to the Indigenous communities—which became a prevalent approach at the turn of the 21st century (Guajardo, Guajardo, & Locke, 2017; La Salle & Hutchings, 2018; Reiter & Oslender, 2015; Smith, 1999). Data collection for this article primarily occurred through unstructured interviews with the respective scholars and source communities. Additional data were obtained through website usability tests and content analysis.

Technological Missionaries

Academics and activists (although not mutually exclusive) have made efforts to bring their technological talents to collaborate with Indigenous communities in planning, using, and developing ICTs. As Guillermo Delgado (2002) notes, "Every summer, thousands of North American and European students who have computer skills make their way south to work with Indigenous organizations" (p. 50). This phenomenon is not limited to Latin America, but also occurs with Indigenous nations in Canada, the United States, and Australia. For instance, Hans-Werner Braun, who founded the High Performance Wireless Research and Education Network in San Diego, California, included the region's tribal communities as beneficiaries of Internet access in drafting his 2000 National Science Foundation grant (Benton Foundation, 2001). However, Braun was very forthcoming with the tribes in stating "I am not a service provider," thereby indicating that although his project would help lay the groundwork for connectivity, it was incumbent on them to learn how to install and maintain the equipment for themselves (Sandvig, 2012, p. 175). Over the next few years, between a mix of trial and error, Native technicians designed and built the 23 solar-operated relay towers that extend wireless broadband coverage across 600 miles of tribal lands, forming what is now known as the Tribal Digital Village (Fetterman, 2013; Rantanen, 2010).

In 2003, shortly after the Tribal Digital Village went live, another researcher, Ramesh Srinivasan, met with representatives from the 19 tribes serviced by the Tribal Digital Village to create an "interactive living digital heritage site" called Tribal P.E.A.C.E.—Preserving Education and Cultural Expression (Srinivasan, 2007). At the time, Srinivasan was a graduate student at Harvard and this project formed part of his dissertation. In 2007, two years after graduating, Srinivasan revisited the project, finding that "Tribal P.E.A.C.E. maintains approximately 400 users and 250 pieces of content to be shared across the 19 Native American reservations" (Srinivasan, 2007, p. 729). Since then, he has undertaken research in rural India, Mexico, and Egypt, but has not returned to the San Diego reservations nor has he visited his former project. To be fair, he never seemed to consider Tribal P.E.A.C.E. his database as much as it was a digital tool for the people to use as they saw fit. When I informed him that several years ago they changed the site to A.C.O.R.N. (A Community-Oriented Repository for Natives), it was the first he had heard of it, and he was genuinely "pleased to hear that they are taking claim of the site" (Srinivasan, personal communication, October 5, 2016).

Srinivasan was part of a larger trend of researchers collaborating with Indigenous communities to produce digital heritage projects (see Tables 1 and 2). Between 2002 and 2007, there were at least four other grant-funded, highly publicized projects in locations ranging from Northern Australia to British Columbia. In each case, the researcher(s) collaborated with the community to create either a virtual exhibition or a content management system for cultural heritage.

Table 1. Indigenous Digital Heritage Projects.

Researcher	Production years[a]	Project	Culture site
K. Christen	2005–2007	Mukurtu Wumpurrarni-kari archive	Warumungu, NT, Australia
R. Srinivasan	2003–2004	Tribal P.E.A.C.E. website	Southern California tribal consortium
D. Shorter	2002–2005	Vachiam Eecha: Planting the Seeds virtual exhibition	Yoeme in the United States & Mexico
H. Verran & M. Christie	2003–2006	IKRMNA database	Northern Australia Aboriginal groups
A. Ridington & K. Hennessy	2005–2007	Dane Wajich virtual exhibition	Doig River First Nation, BC, Canada

Note. P.E.A.C.E. = Preserving Education and Cultural Expression; IKRMNA = Indigenous Knowledge and Resource Management in Northern Australia.
[a]The years listed are approximations of when the researcher collaborated with the community regarding the design for the digital heritage project and when the project went live.

Table 2. Project Descriptions.

Project	Project description[a]
Mukurtu Wumpurrarni-kari archive	Built from the ground up as a stand-alone, browser-based, community digital archive for the Warumungu community embedding community protocols around the viewing, circulation, and creation of cultural material and knowledge directly into the archival platform. Closed system. Password protected. Hosted by the Aboriginal community on a server at the Nyinkka Nyunyu Art & Culture Centre in Tennant Creek, NT, Australia. Became the catalyst for the production of the Mukurtu CMS open-source platform.
Tribal P.E.A.C.E (Preserving Education and Cultural Expression)	An intertribal living digital archive that allows members to post, share, and comment on Indigenous content. Originally Flash-based interface. Password protected. Hosted by the tribes on the Tribal Digital Village. In 2014, the community changed the name to A.C.O.R.N. (A Community-Oriented Repository for Natives).
Vachiam Eecha: Planting the Seeds	Online exhibition of multimedia materials drawing from Yoeme Indian language and aesthetics to demonstrate how one group combines religiosity, indigeneity, and ritual performance to assert sovereignty over their homelands. Converted from Flash-based interface in 2012. Open access. Originally hosted by New York University's Hemispheric Institute as part of their "Web Cuadernos" project. Second edition hosted by the University of California, Los Angeles.
IKRMNA (Indigenous Knowledge and Resource Management in Northern Australia) database	A three-year project to support and develop Indigenous databases that maintain and enhance the strength of local languages, cultures, and environments in Northern Australia. Resulted in envisioning TAMI (Text, Audio, Movies, and Images), a cataloging-type software that aimed at providing a visually based system for perpetuating collective knowledge traditions. Drafts of the TAMI design held at Charles Darwin University.
Dane Wajich—Dane-zaa Stories & Songs: Dreamers and the Land	A collaborative multimedia virtual exhibition integrating subtitled Dane-zaa and English video narratives, interpretive e-text, photographs of the production process, recordings of songs, and contemporary and archival images of traditional lands. Flash-based interface. Open access. Hosted by the Virtual Museum of Canada.

[a]The project descriptions are paraphrased from the official websites and researcher publications

However, not all were created equal. In one case (Warumungu), the community wanted its digital archive to be entirely offline to secure its information, and in other cases (Doig River First Nations and Yoeme), the content was shared online as virtual exhibitions. Three of the projects (Dane Wajich, Vachiam Eecha, and IKRMNA) were hosted by institutional servers located off Native lands (Virtual Museums of Canada, New York University, and Charles Darwin University, respectively). All, except IKRMNA, had project origins as graduate school fieldwork,[2] thus illustrating Delgado's previously mentioned claim about students with computer skills heading into Indigenous lands, and giving credence to the concept of "technologically equipped missionaries" as put forth by Sandvig (2012, p. 176).[3]

For most of the researchers in question, the creation of a digital heritage program was part of their dissertation, and, like all good scholars, they would take the lessons learned, build on them, and move on to other projects. As an article in *The Chronicle of Higher Education* reminds us, "The dissertation should be a stage of the educational journey, not to be retraced, but to be used as a steppingstone to edge further down the path" (Alexander, 2014, para. 22). Therefore, these researchers are "not service providers," but scholars who do not intend to serve as product support for the life of the system. Yet, the researchers did use the most state-of-the-art programming platform as a basis for their work. Unfortunately, at the time, the platform was Flash.

Adobe Flash is notoriously "buggy," frequently crashing or buffering, and requires the user to install plug-ins that are not supported by most current browsers. Once the Internet standard for graphics and video, Flash is now one of the largest online security liabilities, and it has been reported that "computer scripts written in Flash can directly access the memory on your computer, which is just inviting attacks" (Yahoo Tech, 2015, para. 6). Just to illustrate, the "so-called drive-by attacks, which allow hackers to take over computers when users simply view a site, often use vulnerabilities in Flash" (Gibbs, 2015, para. 4). Many online publications have called for its "death" (Barrett, 2015; Bradley, 2017; Franklin, 2015; Gibbs, 2015; Shankland, 2015), and exactly 10 years after Steve Jobs (2010) led the charge in his open letter against Flash, Adobe set the end-of-life date for the software in 2020 (Adobe, 2017). Needless to say, programs currently based on this platform are outdated and nearly impossible to operate because browsers and security suites block their functionality. For instance, Tribal P.E.A.C.E. was Flash-based, and is no longer functioning as originally designed. Matthew Rantanen, head of the Tribal Digital Village where Tribal P.E.A.C.E. is housed, said that "it became clunky and difficult to use. And the constant buffering would cause the system to time out and it was just frustrating" (personal communication, October 4, 2016).

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[2] Srinivasan's Tribal P.E.A.C.E. was part of his PhD in design studies at Harvard; Shorter's Vachiam Eecha: Planting the Seeds website and Christen's Mukurtu database were developed from their graduate fieldwork in the history of consciousness at the University of California, Santa Cruz; the Dane Wajich virtual exhibition formed part of Hennessy's PhD in anthropology at the University of British Columbia and Ridington's PhD in folklore at Memorial University of Newfoundland.

[3] Srinivasan (2017) levied similar criticisms against Hans Werner Braun in his recent book *Whose Global Village?* when he stated that, "Despite his perhaps benign intentions, Braun's perspective represents the common teleology of the heroic scientist or engineer. The dogma associated with a 'technical solution' is far too easily imposed on 'needy' rural, immigrant, and indigenous communities worldwide" (p. 144).

The Vachiam Eecha: Planting the Seeds virtual exhibition of Yoeme culture produced by David Shorter was also published in Flash in 2005. In its original form, the exhibition had a dynamic interface punctuated by Yoeme Deer Dancing, but the current site (updated in 2012) is significantly more static, with film stills and text replacing those performances. When I inquired as to why he came out with a revised version of the site, Shorter noted that the university servers

> stopped supporting Flash . . . and Real Media Player was not going to get full support by the new versions of Safari and Chrome. I was told I had to change it. I find it now more flat and less interactive. Bummed, but didn't have a choice if I wanted to get the site to be supported by my University's technological unit. (personal communication, November 9, 2016)

Thus, researchers are at the whim of available computer platforms as well as their own institutional tech departments.

The Dane Wajich—Dane-zaa Stories and Songs: Dreamers and the Land virtual exhibition, curated by Kate Hennessy and Amber Ridington (2007) and hosted by the Virtual Museum of Canada, lists the requirements of Adobe Flash and Apple QuickTime to view the site. QuickTime has suffered the same security vulnerabilities as Flash. As of early 2016, Apple has ended the support for Windows, prompting the Cybersecurity and Infrastructure Security Agency (or CISA, a division of the U.S. Department of Homeland Security) to issue a warning that running QuickTime can expose "cybersecurity dangers, such as increased risks of malicious attacks or electronic data loss" (Cybersecurity and Infrastructure Security Agency, 2016). As to the fate of virtual exhibitions using such programs, Marc Beck, program officer at the Virtual Museum of Canada responded thus:

> Older exhibits, that may have been developed in Flash, for example, are either decommissioned after 5 or 10 years (pending choice of the institution) or would be transferred over to the institution (original producer) to host on their site at which point they can upgrade the exhibit at their own expense. We do not have the staff available in house to update exhibits. (Beck, personal communication, December 21, 2016)

Hence, the 2007 Dane Wajich virtual exhibition will be sent to a new server, and when it gets there, it will need to be updated with the newest software available.

Because the Mukurtu Wumpurrarni-kari archive was "built from the ground up as a stand-alone" system (Mukurtu, n.d., para. 1), it would seem to be able to circumvent the issues plaguing some of the previous examples. Project director Kimberly Christen worked with the Warumungu Aboriginal community starting in 1995 for her master's degree fieldwork, and by 2005, she responded to their needs of creating a digital archive (Christen, 2005). In 2007, the custom-made archive was installed on a server at the Nyinkka Nyunyu Art and Culture Centre in Tennant Creek, Northern Territory, Australia, and is only accessible on-site, exclusively to Aboriginal community members, not the general public. As noted in several of her publications (Christen, 2008, 2011, 2012, 2015a, 2015b; Christen & Anderson, 2019; Christen, Merrill, &

Wynne, 2017), this archive became the catalyst for the Mukurtu CMS open-source platform, which is now in its 2.1 version and is available as a mobile app.

Several questions came to mind regarding this system: What about updates for the Warumungu who are still using the original alpha version of the software? I realize that it is a custom-made program specifically for that Aboriginal group, but after 10 years, is it still meeting their needs? And what about the server it is on? Did they have to migrate the database to a new computer, or is it still running on the same machine on which it was originally installed? The support team at Mukurtu CMS referred me to Christen's publications, but her writings on the Wumpurrarni-kari archive focus on the initial build and establishment of the program for the Warumungu, not its continuing use. Any recent references to the Warumungu archive are to highlight its existence as the impetus for her subsequent projects: The Plateau People's Project or the new Mukurtu CMS 2.1 (Christen 2011, 2012; Christen & Anderson, 2019; Christen, Merrill, & Wynne, 2017). Only one article (Christen, 2015b, p. 64) briefly mentions an update to the Mukurtu Wumpurrarni-kari archive, which occurred in 2009, but that predates the beta version of Mukurtu CMS; since then, there are no published accounts that discuss user statistics or updates to this early version of Mukurtu. I corresponded with Kimberly Christen, but she was unwilling to go on the record regarding the ongoing functionality and use of the alpha version in Tennant Creek. Accordingly, there is a significant lack of information regarding this particular archive from when it originated in 2007 to when it became inaccessible to users in 2017 because it closed for refurbishments. The Julalikari Council Aboriginal Corporation, which operates the Nyinkka Nyunyu and Culture Centre, recently posted a statement regarding Mukurtu (see Figure 1) that states that the system will be updated to an online format (and perhaps a name change), thus indicating that it did not have a newer version of Mukurtu CMS installed.

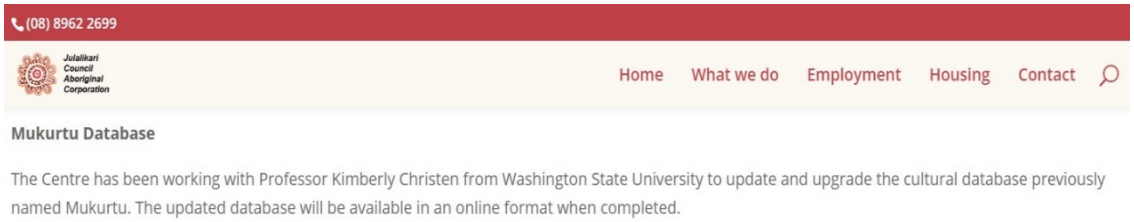

Figure 1. Julalikari Council Aboriginal Corporation website statement regarding upgrade of system (accessed June 2019).

Regarding the current status of the Mukurtu Wumpurrarni-kari archive, Hanna Kothe, interim manager of the Centre, stated:

> Kim Christen has been working hard to keep Mukurtu afloat and active. The challenges were more around organisational funding for the Nyinkka Nyunyu Centre as a whole, particularly when funding was lost for the local community worker who kept the database going on a day-to-day level. (Kothe, personal communication, January 29, 2019)

In essence, this community is in need of both financial and human resources to help manage this particular piece of information architecture.

Upgrades and Funding

Almost 20 years ago, Guillermo Delgado (2002) argued that

> the first generations of donated computers have already been turned into junk by the fast pace of cybernetic progress in the developed world . . . upgrading and updating software and computers has become a priority for many Indigenous organizations, a matter of survival. (p. 50)

This sentiment has been echoed by Matthew Rantanen, head of the Tribal Digital Village, when he stated, "There are plenty of grants for establishing a *new* site or setting up a *new* system, but there's really no aid to help us refurbish or update. We're on our own for that" (personal communication, October 4, 2016). According to both Delgado and Rantanen, Indigenous communities have depended on relationships with researchers, universities, and nongovernmental organizations to assist them in developing ICTs. The ability to network with such individuals and organizations has led to the formation of social networks such as the First Mile consortium in Canada, which shares ICT experiences between First Nations communities to help them fund, design, and implement broadband systems for rural and remote communities. In other words, many Indigenous groups have to locate financial resources to help support their digital projects. Of course, university researchers are often in a similar situation regarding funding.

Helen Verran and her team worked on IKRMNA to research and develop a computer program called TAMI (Text, Audio, Music, and Images). This system would have been "ontologically flat" in its design, while remaining "faithful to the principles and practices of Indigenous knowledge production" (Verran, Christie, Anbins-King, Van Weeren, & Yunupingu, 2007, p. 132). Verran (2009) describes it as

> a completely fluid file management and database system which bears with it no Western assumptions about knowledge or the ecology, and which maximizes the possibility for the user to creatively relate and annotate assemblages of resources for their own purposes. (p. 178)

For three years (2003–2006), the IKRMNA team met with Aboriginal community members, conducted audits of existing databases, and led workshops in their efforts to create a "database and file management system for Indigenous use" (Verran et al., 2007, p. 132). However, they ran out of funding, and the TAMI software was never created. To this day, the program exists only as "electronic proofs of concept" on the IRKMNA website.[4]

[4] The reason for posting the TAMI database conceptual design is the "hope to interest others. In particular, we have in mind those people with access to funding sources, and 'code crunchers' who might be interested in the task of concocting it" (Verran et al., 2007, p. 131).

Another Australian digital archive, the Ara Irititja project (meaning "stories from long ago"), had similar issues regarding sustainability. This custom-built digital archive, created in 1994 at the behest of the Anangu communities (Ngaanyatjarra, Pitjantjatjara, and Yankunytjatjara peoples), is used to store digitally repatriated historical records and to collect new oral histories and audiovisual files.[5] According to its website,

> Anangu view Ara Irititja as an on-going essential project. Regrettably funding has never adequately addressed that view and long-term sustainability is an issue of very great concern. . . . It is a ground-breaking project for which communities have no established funding sources. It does not receive any sponsorship and can only survive from year to year with the financial support of the State and Federal Governments and philanthropic organisations. (Ara Irititja Aboriginal Corporation, 2019, Challenges section)

It bears mentioning that part of this archive included a series of mobile units called "niri-niri" that were deployed in the field on the back of Toyota trucks in order to reach remote Central Australian Aboriginal communities (Hughes & Dallwitz, 2007, p. 154). Therefore, technology costs were not limited to a single heritage center with a steady Internet connection, but to the 67 computers running the database in a variety of venues, including schools, a women's center, and an elder-care facility (Scales, Burke, Dallwitz, Lowish, & Mann, 2013, pp. 154–157). According to one report, "the Aṟa Irititja software and project, developed by Martin Hughes and John Dallwitz, [was] initially a project owned by the Aṉangu people of the Pitjantjatjara communities. The software has been adopted in many parts of Australia" (Ormand-Parker, Corn, Fforde, Obata, & O'Sullivan, 2013, p. vii). To ensure the success of their project, Anangu relinquished their software rights during the process of several builds and, as of 2011, Ara Irititja has been redesigned as a browser-based heritage management system. This new platform, now known as Keeping Culture KMS, is licensed by the developer, Douglas Mann of Rightside Response. Regarding royalties or profit-sharing with the Aṉangu people, I received the following response from Mann:

> Aṉangu do not receive a royalty from the licensing of the software. . . . However, it would be inaccurate to assume that Aṉangu do not benefit in other ways from this arrangement. Obviously Aṉangu do benefit from the upgrades, improvements and support that come from ongoing development of the software. But perhaps less recognised, and underestimated, is the objective of long-term sustainability of this niche software. This is a critical consideration for Aṉangu, who are the biggest users of the software and have a significant interest in seeing the software flourish into the future. It is through an independent and commercial business model that the software is now in a strong and enduring position to ensure that the Aṟa Irititja legacy continues for many years to come. (personal communication, January 18, 2017)

Thus, Aṉangu have entered into business–client relationship to maintain the software support, stability, and certainty that come with a paid product.

[5] As a whole, the Aṟa Irititja project consists of the archive, a website, and an informational exhibition that traveled from 2003 to 2005.

Mukurtu CMS, with its origins in the Wumpurrarni-kari archive, shares a similar genealogy as Keeping Culture KMS, but it is open source, and therefore does not charge a licensing fee. Instead, the research and development are entirely grant-funded. On the Mukurtu CMS website, the developers list their funding history as a series of multiyear grants, primarily awarded by the U.S. National Endowment for the Humanities. However, the changing political climate, along with an already competitive grant environment, means that the long-term sustainability of this platform is uncertain.[6] In addition to the fickle nature of grant funding, Mukurtu is staffed by people who are doing double duty as instructors and archivists rather than principally servicing Mukurtu clients' needs, so that the retention of current users (and the development of new users) may be challenging.[7] For instance, at a site-building and community engagement workshop held in 2015, two attendees remarked on their experience with Mukurtu CMS. One person claimed that she "tried unsuccessfully to implement a previous version of Mukurtu on her own and moved on to other solutions," and another person is "using Past Perfect currently, gave up on Mukurtu 1.0 previously" (Wynne, 2015, pp. 1–2). Of course, these cases are somewhat general in nature and could be applied to any experience with software. Still, users who pay licensing fees expect a certain level of customer service and may be more apt to stay and work with the software rather than abandoning it.[8]

Beyond Obsolescence

If an Indigenous digital heritage site is no longer functioning correctly, then what does that mean for the knowledge generated through the project? For example, during their collaboration with the Dane-zaa (Doig River First Nation) to create an oral history virtual exhibition, anthropologists Hennessy and Ridington recorded an incident in which the chief brought a 100-year-old drum skin to one of the website planning meetings (Hennessy, 2012. Elders recognized the drawings on the skin as belonging to a noted Dreamer from their community, and it elicited several stories and songs from tribal members. The drum thus became the "central symbol and guiding metaphor" for the website. As the digital project entered its final draft, the Doig River First Nations community felt that the Dreamer's drawings were not appropriate for worldwide circulation. Furthermore, a neighboring Dane-zaa band, the Blueberry River First Nation, objected to the use of archival photographs that featured their family members, and refused to grant permission for online publication (Hennessy, 2009, 2012). Respecting the larger community wishes, the

[6] According to Shepard (2014), "While Mukurtu has been quite successful at obtaining grants, they realize the long-term unsustainability of being solely grant-funded. Director Christen envisions that the CoMunn project will develop a consistent revenue stream able to support continued operation of the CMS" (p. 323). But as of 2018, the CoMunn project (a hosting service) is nonexistent.

[7] Mukurtu CMS is developed and maintained by the Center for Digital Scholarship and Curation (CDSC) at Washington State University. In addition to providing support for Mukurtu CMS users, staff at the CDSC also offer digital training and workshops for other platforms such as Story Maps, Scalar, and Adobe Spark (per the CDSC website).

[8] Christen (2015b) notes the need to improve service support of Mukurtu CMS, with "a strategy that includes creating 'Mukurtu hubs'—regional institutions that provide Mukurtu training and Mukurtu stewards—and training individuals in the most recent Mukurtu functions and use to share their knowledge locally" (pp. 67–68). In 2016, Mukurtu CMS received a three-year grant to implement this style of Agile software development, and its initial implementation is discussed in an article by the Mukurtu team (Christen, Merrill, & Wynne, 2017).

curator-anthropologists removed several photographs, and replaced the Dreamer's painted drum on the homepage with an unpainted, plain drum skin instead (see Figure 2).

Figure 2. Homepage of Dane Wajich—Dane-zaa Stories and Songs: Dreamers and the Land.

Throughout the site, drum iconography allows visitors to access interactive maps and approximately three dozen multimedia files of Dane-zaa storytelling and singing created for the project. But because these files are accessible only with QuickTime or are Flash enabled, most Web browsers automatically block the content. If not readily available, the information is not entirely lost. Full transcripts of the videos and song lyrics are available on the site, and the articles written about the project are accessible, that is, if one has institutional access to journal subscriptions. In essence, the knowledge generated through the project is still obtainable, but not through the official final product (the website) as originally designed.

Collaborative Process

Perhaps the argument can be made that these digital projects are about the process and not the final product. Certainly this is true of IKRMNA, a project that spent three years in consultation with Aboriginal communities to develop an Indigenous-designed database that was never realized. In a similar fashion, Ramesh Srinivasan is known for his concept of "fluid ontologies," a method of creating flexible knowledge structures through a dialogic process that constantly evolves with the continuing input of its participants

(Srinivasan & Huang, 2005). In layman's terms, it is an adaptive database designed after a series of consultations with community members who arrive at a consensus regarding the classifications, tags, and labels that best represent their local knowledge traditions. This approach to Indigenous site design is frequently cited in literature dealing with Aboriginal digital humanities (Christie, 2005; Giannachi, 2016; Horst & Miller, 2012; Ormand-Parker et al., 2013). However, scholars citing this work focus on the perceived benefits of the collaborative design process rather than whether a particular site is still functioning as designed.

Not all scholars are enamored with collaborative practice with regards to cultural resource management. According to Marina La Salle and Richard Hutchings (2018), collaboration is "colonial whitewash" that is "ultimately rooted in cooptation and dependence" that does little to actually "decolonize" the structures of power (p. 1). For them, when "collaboration is seen as the means and the end," it ultimately results in "less power to Indigenous communities" (p. 12). Their arguments are persuasive, particularly if we are to assume that these digital projects are about the collaborative process and not the final product. It raises the question: Whose interests are being served? For most of the examples discussed here, the researchers benefit from the ability to reference the collaboration (and any theories or methodologies developed therewith) in academic publications, but the Indigenous community is effectively left with a piece of (in some cases, proprietary) software that, without sustained involvement from Native and non-Native stewards, becomes unusable to the community. But do the Indigenous communities really lack the capacity to maintain these digital heritage projects?

Digital Self-Determination

Although it has been noted that there are different degrees of ability with information technology within Indian country (Christen, 2015a; Christen, Merrill, & Wynne, 2017; Dyson et al., 2007; Fish, 2011), the fact remains that "Aboriginal people [are] remaining users, but not managers, of their own archives" (Ormand-Parker, Corn, Fforde, Obata, & Sloggett, 2012, p. 203). Although there has been a concerted effort to design heritage projects that adhere to Indigenous cultural protocols, it is the elders who are often the "users" that seek the digital realm as a "safe keeping place" for their traditional knowledge (Christen, 2005). As Verran (2009) notes, "Some [elders] feel that many in the younger generation are growing up without a robust Indigenous identity based in a strong grasp of their community's knowledge traditions. These elders endorse the use of computer databases and other digital technologies" (p. 178). Because Native elders are not coding or producing the digital heritage projects themselves, university researchers have stepped in to help (Delgado, 2002; Nakamura & Chow-White, 2012). This is not to say that the Native youth are excluded from digital heritage. In most Indigenous communities, there is an assumed "tradition of reciprocity," which holds that there is an "obligation of elders to teach younger generations their traditional knowledge and the reciprocal obligation of the young to teach their elders how to use the technology to keep up their traditions" (Ormand-Parker et al., 2013, p. vi). Although an intergenerational approach to Internet training is one step toward maintaining digital heritage sites, Indigenous communities need to make a larger effort at data governance and IT management if they wish to achieve data sovereignty.

Conclusion

My point in exposing the vulnerabilities with grant-funded software design, and earlier outdated digital projects, is to draw attention to the fact that these are heritage projects in which the Indigenous communities expect a degree of sustainability in the work of the researcher and project designer. Almost all cases discussed here (except for IKRMNA) involve "born digital" community-generated content and metadata that will be potentially lost if not maintained appropriately. The UNESCO Charter on the Preservation of Digital Heritage that was adopted in 2003—while most of these projects were being developed—states,

> Digital heritage is at risk of being lost to posterity. Contributing factors include the rapid obsolescence of the hardware and software which brings it to life, uncertainties about resources, responsibility and methods for maintenance and preservation, and the lack of supportive legislation. (Article 3)

Thus, any "born digital" items left on outdated software run the risk of entering the "digital dark age" that Internet pioneer Vint Cerf has declared will enviably happen (Rocca, 2018). Perhaps future ICT design will facilitate digital preservation with international standards that will allow for self-preserving objects that will be safeguarded against the frequent technological changes (Colley, 2015). But until then, researchers working with Indigenous communities should ensure that the groups have a digital maintenance plan in place before leaving to start new projects.

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