



Heritage making through community archaeology and the spatial humanities

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ABSTRACT

The archaeology of postindustrial landscapes is still relatively undeveloped. The impact of economic, social, and urban development efforts on both tangible and intangible heritage complicate our attempts to understand these places. Despite this, integrating heritage practice and promotion into the regeneration of a postindustrial landscape continues to grow in popularity. Within this context, genuine public-expert collaboration is the most effective means towards developing a sustainable compromise between protecting community heritage values and fostering economic development and regeneration. In this paper, we suggest three broad categories of challenges for studying and promoting heritage in postindustrial regions – *physical*, *social*, and *political* – and propose a digital data-focused geospatial approach to how community archaeologists and heritage specialists may overcome these challenges. We argue that coupling this data and technology with a robust research agenda and public programming can serve as a crucial two-way link, enabling long-term sustainable heritage-promotion and protection in post-industrial communities.

KEYWORDS

Postindustrial; heritage; archaeology; spatial humanities; GIS

Introduction

The Keweenaw Time Traveler (KeTT) Project is an interdisciplinary project that applies digital, spatial approaches to the study of a former copper mining region in northern Michigan. While the KeTT supports research within the academy from a variety of disciplinary perspectives, the KeTT also focuses on fostering citizen science and community heritage-making. The present study identifies several key challenges that the KeTT team faced in undertaking this work within a postindustrial community, and reflects on the lessons the experience can offer practitioners of community heritage and archaeology.

The challenges of postindustrial heritage landscapes

Working within landscapes that have experienced the processes of deindustrialization presents archaeologists and heritage professionals with a distinct set of challenges. The formal study of deindustrialization is a relatively recent phenomenon (High 2013), and consequentially the process of understanding the heritage of postindustrial places remains in its early stages. Heritage itself is often seen as a tool for economic regeneration, and while this can be problematic (Watson and González-Rodríguez 2015), the concept of integrating heritage-making, heritage conservation and post-industrial redevelopment clearly has potential (Cizler, Pizzera, and Fischer 2014). Within this context,

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we have identified three broad categories of challenges – *physical*, *social*, and *political* – that complicate postindustrial heritage landscapes.

In its most straightforward *physical* sense, deindustrialization's legacy has been one of abandonment and ruination, as large swathes of manufacturing complexes left idle for decades have suffered from physical neglect and vandalism, and depopulation has left many neighbourhoods empty (Mah 2012). Industrial landscapes are composed of a complex, large-scale, interrelated series of sites representing all of the stages of production and the transportation networks that linked them together, along with their associated communities (Palmer and Neaverson 1998; Stuart 2012). Processes of physical ruination are geographically uneven, resulting in a postindustrial landscape where this historic physical fabric is in some places prominent, in others visible only to the archaeologist. Despite their impressive scale, industrial ruins are also fragile (Tempel 2012). This makes it difficult for experts, professionals, and the public alike to see physical contexts that may be crucial to the local heritage.

Postindustrial landscapes face increasing physical development pressures and developing a mutually beneficial balance between heritage conservation and development planning has become increasingly important (Barber 2013; Bertacchini and Segre 2016; Appendino 2017). Environmental sustainability considerations are becoming increasingly central to planning and development efforts, and the treatment of tangible heritage must also fit within this paradigm (Balliana et al. 2016; Nocca 2017). Balancing all of these needs will often lead to difficult choices, and it is important that all parties involved in this process are able to contextualize effectively the physical heritage landscape. How can the various visible fragments of the historical landscape be articulated effectively with each other? How do we advocate for heritage in ways that preserve these contexts while meeting pressing economic and environmental sustainability needs? Stabilizing and clearly connecting physically extant portions of the postindustrial heritage landscape with 'lost' elements or less visible archaeological remains represents an important *physical* challenge.

A key focus of deindustrialization scholarship has been its *social* consequences, the 'economic and political ruination' suffered by tens of millions of people, the majority of them working class, as a result of the collapse of manufacturing industries (High, MacKinnon, and Perchard 2017, 4). While the social networks of postindustrial communities have often proven to be remarkably resilient, the transnational movements of capital that characterize today's global economy have left these communities behind (High, MacKinnon, and Perchard 2017). Attempts to remedy this situation in postindustrial places have met with mixed success because the benefits of recovery are distributed unequally (Mallach 2018): while postindustrial *places* may appear to recover, all too often those industrial *communities* that suffered most directly when the factories closed do not (High, MacKinnon, and Perchard 2017). Since heritage landscapes are composed of a combination of interconnected tangible and intangible components, the loss of these industrial communities as a byproduct of redevelopment is just as destructive to the heritage landscape as any physical damage to its historic fabric. A second challenge we face, therefore, is effectively to populate our physical representations of the landscape, past and present, with their attendant *social* networks in order help maintain the visibility and viability of the latter.

Finally, we identify as *political* the challenges associated with fostering genuine multi-vocal heritage-making within postindustrial heritage landscapes. We are keenly aware of the injustices and inequalities inherent in single, expert-generated heritage narratives that a growing body of critical heritage scholarship has exposed (Meskell 2015; Baird 2017). Any heritage landscape formed even partially by processes of deindustrialization is necessarily constituted from a tangle of heritage values that are 'dissonant' (Tunbridge and Ashworth 1996) and multivocal. It is our task to support this understanding of heritage to the greatest extent possible. How can we, as the 'experts', make space for this dynamic and conflicting collective of memories (Belford 2015; Orange 2015) that are a crucial component of the postindustrial landscape? Expert-led community engagement, however well intentioned, does not necessarily alter the power balance of a single, dominant heritage narrative (Smith 2006), and so we must constantly be reflexive in evaluating our project's ability to support multivocality.

Above we have characterized postindustrial heritage landscapes and three challenges they face in a general sense. It is, however, important to recognize the localized nature of deindustrialization. Each deindustrializing community or region has experienced this process in specific ways according to local historical sociopolitical dynamics, the type of industrial base each community was built upon, and the success (or failure) of efforts to transition to a postindustrial economy (Berger and Wicke 2017). With this in mind, we present a brief sketch of the Copper Country, the postindustrial heritage landscape that serves as our case study.

The copper country as a postindustrial heritage landscape

Upper Michigan's Copper Country takes its name from the unusually pure copper found there (Krause 1992). Native Americans in the Upper Great Lakes discovered and made use of these copper deposits for millennia and first established the region's reputation as a source of pure copper. Native groups revealed these copper sources to European explorers as early as the seventeenth century (Krause 1992); subsequent Euro-American copper exploration often relied on native knowledge, both ancient and contemporary, to locate the deposits that became the focus of historical mining activities (Krause 1992). Beginning in the 1830s, Ojibwe bands living in the upper Great lakes signed treaties ceding huge tracts of land in present-day Michigan, Wisconsin, and Minnesota to the USA, and moved to reservations that those treaties established (Satz 1996; GLIFWC 2018). By the 1840s, Euro-American mineral exploration in the region initiated the first in a series of copper mining booms. The region grew to become a nationally significant source of copper during the second half of the nineteenth century, just as large-scale electrification projects in the USA made this already culturally and economically significant mineral indispensable (Lankton 1991). This very long association with copper extraction remains strongly evident in both the physical and cultural landscapes to this day, more than half a century after the cessation of the last large-scale mining operation in the area (Lankton 2010, see Figure 1).

Today, the Copper Country sits within Keweenaw, Houghton, and portions of Baraga and Ontonagon counties in Michigan's Upper Peninsula (Figure 2). This encompasses several substantial towns



Figure 1. The Copper Country's postindustrial heritage landscape is composed of a mixture of extant and "missing" physical and cultural elements, both contemporary and historic. (Illustration: Lynette Webber / National Park Service).



Figure 2. The Copper Country encompasses the shaded portion of the Keweenaw Peninsula and is located on the southern shores of Lake Superior in Upper Michigan. (Illustration: Dan Trepal).

and numerous smaller villages set within over 2,000 square miles of rural, mostly forested land. The Copper Country is a postindustrial heritage landscape with vast physical remains of mining sites, both large and small, ancient and more recent. Among the most recognizable of these features are a few preserved shaft rock houses standing over mineshafts, railroad rights-of-way (most of which have been converted into off-road vehicle trails), the ruins of mining buildings such as engine and boiler houses, mills, smelters, and also waste rock and mill tailings piles.

Aside from the physical remains, the heritage landscape also manifests itself in the descendant communities of immigrant groups, such as the Nordic and French-Canadians, who established villages with toponyms that reflect their cultural identities: Frenchtown, Swedetown, Toivola, and Lac Labelle, for example. These settlements are surrounded by the remains of the landscape-scale industrial systems, processes, and social phenomena that led to their creation and drove their subsequent evolution (Arnold and Lafreniere 2017). The end of the copper boom also led to steady depopulation, economic stagnation, and poverty that remain very much visible in the regions' towns and countryside (Winkler et al. 2016).

The byproducts of past industrial activity and their ecological impacts shape this postindustrial landscape in crucial ways. Toxins leaching from waste rock, mill waste, and smelters represent an ongoing ecological threat (Kerfoot et al. 1999; Morin 2013). Huge, shifting deposits of stamp sands (waste rock ground into a form of sand during the milling of copper ore) previously dumped into inland lakes and Lake Superior itself can bury fish spawning grounds and block navigation channels (Yousef et al. 2013). The postindustrial community is burdened with the persistent costs of the historic mining boom without sharing in much, if any, of the wealth it generated (Morin 2013).

The Copper Country's past as a nationally significant extractive landscape, coupled with its vast extant archaeological remains, serves as a focal point of contemporary heritage-making as evidenced by the creation of the Keweenaw National Historical Park in 1994, which focuses on interpreting the historical copper mining era of the region. However, the Copper Country is also cast as a place of great natural beauty, and the local tourist economy – a crucial local source of income and employment – necessarily is shared between mining heritage and outdoor recreation-focused components (Regenold 2007; Lankton 2010). As a result, this landscape cannot be neatly categorized as drawing its significance from primarily natural or cultural, tangible or intangible elements. During the mining era, the copper country experienced seismic social events, including the 1913 miner's strike and related Italian Hall disaster, a deadly stampede that occurred at a Christmas party attended by striking miners and their families (Lankton 1991). Events surrounding the strike remain disputed subjects within the community today, reinforcing the constituted nature of this heritage landscape. Finally, while the community's links to this extractive past are both strong and personal, their own livelihoods also rely substantially on the successful marketing of this heritage to visitors from elsewhere (Liesch 2016).

Spatial approaches to heritage making

The Copper Country, therefore, is a complex postindustrial archaeological and heritage landscape, with strong community ties to its historic role as an important copper mining district (Arnold, Lafreniere, and Scarlett 2019). Facing the physical, social, and political challenges inherent in studying such a landscape, we have initiated an interdisciplinary project focused on applying digital, spatial methods to collaborative knowledge production and heritage making among academics, heritage professionals, and the public at-large. We call this the Keweenaw Time Traveler (KeTT) project. For the KeTT team – historians, archaeologists, geographers, GIS specialists, and computer scientists conducting research of, and within, the Copper Country – our public digital, spatial heritage platform serves as a virtual space for heritage-making (Scarlett et al. 2018). These sophisticated digital representations serve as collaboration tools among the broad public, local heritage professionals, and academic researchers in producing a multifaceted, dynamic understanding of the Copper Country as a postindustrial heritage landscape. The project began as a series of scoping meetings with community partners such as the National Historical Park, other local heritage organizations, libraries, and museums to form a partnership for sharing historical archival material, pooling public outreach resources, and provide public exposure for future KeTT products. The KeTT team then held nine meetings, based on the urban design charrette¹ model, with a broad demographic of community members to learn about what community members would like to see in a web-based interactive map of the historical environments in the region (Lafreniere et al. 2019). During the charrettes, the KeTT team and members of the public tested and critiqued early prototypes of the KeTT web

applications. The charrettes served as a space for the collaborative design of a digital interface that is accessible and focused the design team on content that represents the community's heritage values (Scarlett et al. 2018; Lafreniere et al. 2019). By iteratively repeating this charrette-based model for development of the project, we shift our role towards participating in the collective management of change in our heritage landscape rather than serving merely as experts curating a fixed, monolithic heritage narrative. In order to succeed, this interaction must be accomplished in ways that not only benefit the community, but that the community also substantially drives.

The application of digital, spatial methods to the challenge of achieving genuinely collaborative community-engaged research is still in its early stages. Crowdsourcing has become a popular means for developing a cooperative relationship between cultural heritage experts and the public; such relationships typically revolve around the conversion of large bodies of historical data from one format to another through publicly accessible digital tools (Aucott, Southall, and Ekinsmyth 2019; Ridge 2014; Southall and Lafreniere 2019). The interdisciplinary field of historical GIS (HGIS) has demonstrated the possibility of visualizing and analyzing the past from new, spatially-focused perspectives that can challenge current understandings of the past (Gregory, DeBats, and Lafreniere 2018; Olson and Thornton 2011; Knowles, Cole, and Giordano 2014). HGIS scholars have coupled this visual, spatial approach with the crowdsourcing concept in innovative ways such as georeferencing maps (Vershbow 2013), and transcribing place names from historical cartography (Southall et al. 2017). Some of these projects, such as the New York Public Library's Building Inspector (<https://buildinginspector.nypl.org>), adopt a game-like interface that addictively streamlines crowdsourcing tasks relating to digitizing historical maps such as checking the accuracy of digitized historical building footprints, transcribing text, and recording colour-coded building classifications.

Archaeologists have also begun arguing for new and wider applications of spatial technologies such as GIS, as well as the use of spatial storytelling and augmented reality approaches developed within the digital humanities (González-Tennant 2016; Earley-Spadoni 2017). Gonzalez-Tennant adopted a collaborative, digitally augmented approach to his own archaeological research centring around the destruction of the African-American community of Rosewood, Florida, in the 1920s and the resulting complexities of the archaeology of racial violence and social justice (González-Tennant 2018). His web-accessible Virtual Rosewood Project (<http://www.virtualrosewood.com>) showcases the collaborative potential of digital technologies that can be implemented so as to 'avoid depoliticizing complex histories of disenfranchisement while eliciting poignant and critical reflections from the public' (González-Tennant 2018, 149). The project website couples an interactive 3D digital reconstruction of the town of Rosewood with a traditional historical narrative, transcripts of oral histories from community members, and a digital documentary.

Earley-Spadoni (2017) argues that the discipline of archaeology, long familiar with GIS-based mapping and spatial analysis, can benefit from digitally-based deep mapping, spatial storytelling, and data visualization approaches developed within the digital humanities. Unlike existing implementations of spatial technologies such as GIS in archaeology, these promote open-ended data exploration rather than presenting expert-produced representations or results of analyses; this represents an excellent opportunity for more effective public engagement through collaborative data exploration.

One of the major goals of the KeTT is effective collaboration with the public in heritage-making. However, our subject, the Copper Country, covers a much wider geographic, temporal, and thematic expanse than most spatial projects and thus requires a different methodological approach in how it represents the past. For this, we turn to HGIS and the spatial humanities and apply a series of digitally-based approaches to create a publicly available digital platform. This platform is designed to help academics, professionals, and the public explore and define the Copper Country's heritage landscape together, transparently incorporating widely differing forms of knowledge and leveraging the best features of each in a more inclusive, equitable, and effective heritage making process (Scarlett et al. 2018; Lafreniere et al. 2019). Our approach takes the form of big-data based spatial representations of past and present environments – in the Copper Country – that supports and links together

in one collaborative digital environment several important activities. First, the KeTT supports both academic and public explorations of, and contributions to, our collective knowledge of the regions' historical record and heritage. The KeTT also supports professional management of heritage resources. Finally, the KeTT can also serve as a resource for planners, municipal governments, local nonprofit organizations, and other groups interested in promoting the Copper Country's heritage.

Creating a digital, spatial infrastructure for understanding the past

From a methodological perspective, the focus of our research has been on developing a digital infrastructure that supports a collaborative environment of researchers, professionals, and the public to explore, visualize, manipulate, and analyze postindustrial heritage landscapes across spatio-temporal scales. We call this digital infrastructure a historical spatial data infrastructure (HSDI), and it consists of the hardware and software backend of our public KeTT project web interface (Figure 3). An HSDI is a collaborative digital infrastructure for managing knowledge about a particular space and time, ensuring data interoperability, scalability, common data standards, reliability, and accessibility (Trepal, Lafreniere, and Gilliland *forthcoming*; Lafreniere et al. *forthcoming*). Our implementation of the Copper Country HSDI (CC-HSDI) adopts a multi-stage approach that Lafreniere and Gilliland (2015) first developed, wherein discrete built and social environments or stages are each constructed out of a series of geodatabases; the data are then connected through a complex series of spatial and tabular linkages that adhere to established standards. Within the CC-HSDI, these data are stored in linked, relational spatial databases known as enterprise geodatabases that are easily accessible via

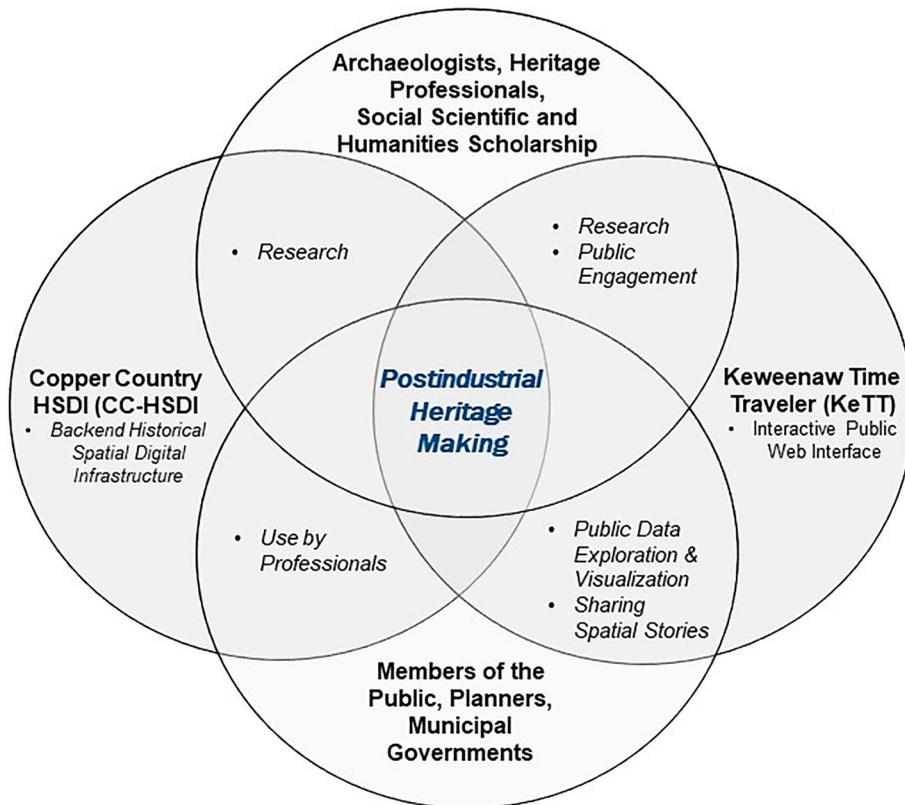


Figure 3. The CC-HSDI and Keweenaw Time Traveler each offer a specific set of potential benefits to academic researchers, professionals, municipalities, and the public. (Illustration: Dan Trepal).

web apps, making the content accessible to, and even editable by, the public (Lafreniere et al. 2019). The CC-HSDI, therefore, is a general-purpose, interdisciplinary infrastructure for the study of the past within the Copper Country. The data in the built and social stages are based largely on the historical record, but stages focusing on the geological and archaeological records have been conceptualized and will be added to future iterations of the CC-HSDI (Trepal, Lafreniere, and Gilliland *forthcoming*). The CC-HSDI project covers a hundred-year period from ~1850 to 1950.

A brief overview of the structure and features of the CC-HSDI sets the stage for a discussion of the value of its application. The CC-HSDI is composed of two stages, the built environment (BE) stage and the social environment (SE) stage, both subject to augmentation. The BE stage is constructed by scanning and georeferencing historical maps and fire insurance plans. Each feature on the maps and plans, such as building footprints, transportation networks, and industrial systems, are digitized into the CC-HSDI, which allows the maps to not only represent historical space, but can be used to capture information about the BE, link to other spatial data, and serve as the foundation of 3D recreations of industrial communities (Arnold and Lafreniere 2017). As of this writing, over 116,000 footprints have been digitized and civic addresses, number of stories, built form, and other building features have been recorded for nearly every 1p years from 1890 to 1950.

The SE stage forms the second key component of the CC-HSDI and consists of a big dataset – approximately 6.9 million pieces of data from over 300,000 individual records thus far – of historical demographic data primarily drawn from four types of historical sources: city directories, the full-count decennial census, mining company employee record cards, and school records (Table 1). We have geocoded these tabular records using a semi-automatic process in ArcGIS in which the addresses within the records are matched to custom historical geocoders built from extracted address information contained within the BE stage. The decennial census data are sourced from the individual level decennial census datasets made available by the Minnesota Population Center in its IPUMS project (Ruggles et al. 2019) and geocoded and linked to the buildings in the BE stage. The mining employee and school records are digitized and geocoded in a similar manner. Sources that lack civic address information are mapped via a semi-automated probabilistic record linkage procedure outlined by Lafreniere and Gilliland (2018). Collectively, these data reveal information on individuals including home and work addresses, occupation, marital status, household composition, whether they rent or own their home, religious affiliation, physical health, national origin, immigration status, languages spoken, and education level. An ongoing initiative involves record linking these sources together in space and time, resulting in a big data-based reconstruction of a century of information regarding family or kin networks, work networks, religious communities, and schoolmates within the Copper Country's broader population. It will allow for spatial-temporal analysis and recreation of complex social processes such as immigration, segregation, social mobility, and the social effects of deindustrialization and job loss. The CC-HSDI already has been used for heritage interpretation and management (Arnold and Lafreniere 2017; Arnold, Lafreniere, and Scarlett *forthcoming*), data-driven history education (Scarlett et al. 2018), and citizen science (Lafreniere et al. *forthcoming*). A more detailed technical description of the CC-HSDI's creation is available in Trepal, Lafreniere, and Gilliland (*forthcoming*).

Through the complex spatial and tabular interlinkages across the CC-HSDI dataset, we can flexibly visualize and explore past environments within the Copper Country in a variety of ways. The KeTT

Table 1. Historical Big Datasets within the CC-HSDI.

Dataset	Number of Records	Variables Per Record	Total Variables
Built Environment Data	116,640 structure footprints	Varies	~ 1,900,000
City Directories	69,401 individual Records	13	902,213
Decennial U.S. Census	~95,000 records	37	~ 3,500,000
Employee Records	498 records	65	32,370
Historical Maps	1,150 maps	N/A	N/A
School Records	25,879 records	19	491,701

encompasses both the collaborative heritage making tools of the CC-HSDI and its application in the public realm. The KeTT is an interdisciplinary public collaboration project, a key component of which is a set of web-based software tools that allow the public to access and explore the data and stories within the CC-HSDI. We have developed four web apps for the KeTT. Three of the apps (entitled 'Document Building Material', 'Transcribe the Map', and 'Document Building Use', and collectively referred to by the team as 'builder apps'), are citizen science tools with game-like interfaces in which the public help add information to the built environment stage geodatabase through various map reading and transcription activities, the results of which are instantaneously available to all KeTT users (Lafreniere et al. [forthcoming](#)).

Here we focus on the fourth app, *the Explore app*. The Explore app allows the public and researchers without specialized knowledge of GIS to exploit the dense and complex spatial and tabular linkages among all of the built and social environment data within the CC-HSDI. The user selects a desired town and year from pull-down menus, and the Explore app automatically displays the appropriate set of historical map data for that place and time, within which the user can pan and zoom to explore. Transparency slider and spyglass tools allow users to peek through time from the historical maps to either a 1940s topographic map or a modern aerial image, allowing users to visualize change. A click on any building depicted on the historical map will call up all of the BE and SE stage data associated with that building for that year. Alternately, the user can search directly for addresses, people, and place names ([Figure 4](#)). Results include entries across space and time, allowing users to trace the movement of people within the Copper Country through the periods of rapid industrialization and deindustrialization.

The Explore app also includes a 'share a story' function ([Figure 5](#)). This feature allows users to contribute their own memories or heritage narratives to the CC-HSDI in the form of illustrated spatialized stories. Users select a location within the Explore app and contribute their content, which can be text along with photographs, audio, or video files. Users may also insert hyperlinks to additional online sources relating to their story. A Facebook plugin allows users to comment on the stories of other contributors and share their knowledge across social media. Stories are instantly searchable by keyword or by clicking its location in the interactive map interface. The 'share a story' function contextualizes users' memories and histories within the vast datasets and the CC-HSDI's historical

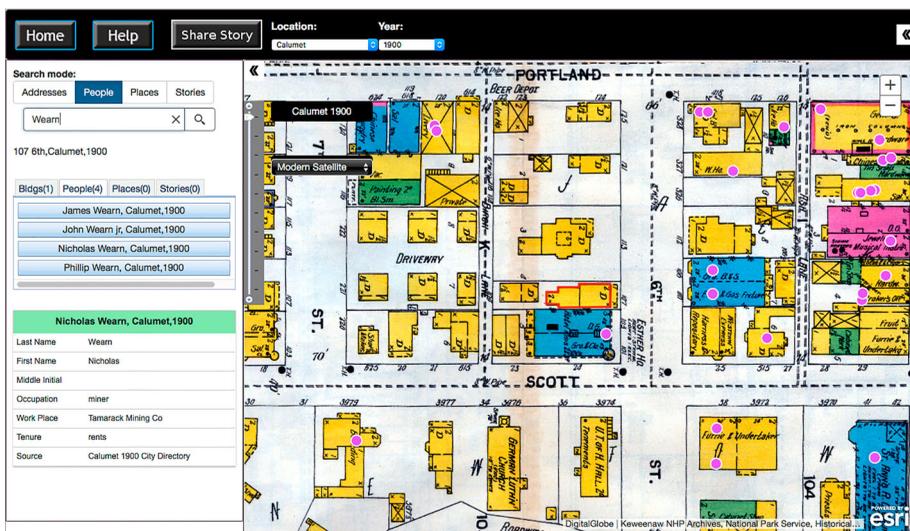


Figure 4. The KeTT Explore App permits users to search for people and places in the past, either through text search or clicking on a location in the map. Search criteria and results are displayed in the panel to the left, while the map in the center dynamically adjusts to the relevant time and location. (Illustration: Keweenaw Time Traveler, Michigan Technological University).

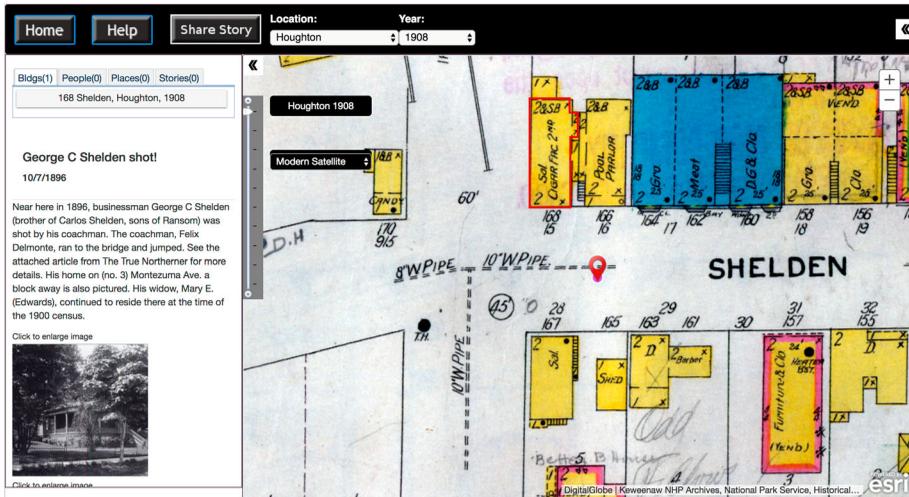


Figure 5. The Share a Story function allows KeTT users of the Explore App to select a location on a historical or contemporary map and input text, photos, videos, or audio. The submitted story then appears on the KeTT interface maps as clickable purple dots. Once clicked, the story is displayed in the pane on the left side of the screen. (Illustration: Keweenaw Time Traveler, Michigan Technological University).

evidence-based reconstruction of past Copper Country environments. This story-sharing feature juxtaposes user-friendly access to rigorous historical record-based information with the sharing of multiple, possibly conflicting, publicly-held memories and identities with the past that collectively constitute the heritage of the Copper Country more broadly.

The Keweenaw Time Traveler as a platform for meeting the challenges of postindustrial heritage landscapes

By providing user-friendly access to big data-based explorations of complex past environments, the KeTT supports collaborative heritage making activities that contribute to addressing the physical, social, and political challenges inherent in post-industrial communities.

Physical

The KeTT web interface contextualizes historical physical and social landscape features in today's spatial context using big historical data, providing the public with virtual access to places that either no longer exist or that may be too dangerous to explore physically. The KeTT makes linkages across time and space in order to capture visually a changing landscape, which then can be understood from a variety of perspectives and in combination with a wide variety of information. In other words, the KeTT provides the context in which experts, professionals, and the public can connect the natural with the cultural, the tangible with the intangible, and the explicit with the implicit. For instance, the precipitous drop in this region's population, from nearly 100,000 residents in the 1910s to about 45,000 in 2019 led to the loss of many domestic and commercial buildings. Remaining apartment buildings and storefronts can be visualized as part of a now-lost historical urban streetscape within the Explore App by using the transparency feature and available historical cartography layers, along with user-submitted historical photos of the buildings. Further, users can explore the social environments that once existed, such as ethnic ghettos, transient worker neighbourhoods, or racially integrated community schools, through the spatialized social environment stage data.

KeTT team members have already employed this kind of contextualizing visualization activity at Michigan Technological University (MTU) within an archaeology field school and several undergraduate history courses. Students in these classes are given GPS-equipped iPads running Esri ArcGIS Explorer App loaded with CC-HSDI's BE and SE stage data used in the KeTT web software. Whether used in the context of an archaeological survey or excavation, or a walk through a neighbourhood in a Copper Country town, the mobile devices allow students to simultaneously move through the visualized historical environments of the KeTT and the same space in the modern post-industrial landscape (Scarlett et al. 2018). This provides students with an immediate and powerful demonstration of the interplay of change and persistence (Arnold and Lafreniere 2017). This same tablet-based mobile employment of the CC-HSDI data also serves as a key component of the KeTT outreach programme, one example of which is the team's participation in a National Park Service programme called Copper TRACES.² The KeTT is one of over 20 stations visited by 400 fourth graders over three days in the former urban hub of Calumet. Using the iPads, students explore the main commercial street in Calumet, learning about the businesses and structures that used to fill now-empty lots. This spatio-temporal orientation better contextualizes exhibitions within the NPS visitor centre displaying photographs and artefacts from missing components of the historical townscape, such as a large YMCA building that once stood in what is now the visitor centre parking lot.

This kind of recreation of physical space is especially important for post-industrial heritage-making. Industrial systems operate at enormous scales and incorporate transportation networks, extraction, production, and processing mechanisms stretching across ever-increasing regional, national, and global spaces. While many large-scale features of the historical industrial landscape remain, in the form of archaeological sites, ruins, and preserved or adaptively reused structures, these are still only fragments of the original industrial systems they supported. Moreover, even the more intact components may not easily be comprehended from one vantage point. These landscapes better communicate their meanings using flexibly scaled representations, and an HSDI. In the Copper Country, while some company structures have been preserved or repurposed, most were dismantled and salvaged by their corporate owners, leaving skeletal ruins, concrete footprints, partial walls, or overgrown brownfield sites. The academic researchers, community members, and visitors alike visualize these changes using both desktop and mobile applications within the KeTT Explore App. In order to balance heritage, sustainability, and development, it is important that all players have the opportunity to contextualize all of the components of the postindustrial landscape to support informed discussion and decision making. The KeTT represents a user-friendly and accessible digital platform to support this process.

Social

The physical remains of past industrial activity may be fragmentary, but they are still visible in the postindustrial landscape. The communities that occupied these landscapes, and their links to contemporary postindustrial communities, may not be as obvious. To address this, the KeTT populates its recreated physical environments with historical communities through the process of geolocating demographic and qualitative historical data sets. By exploring the interplay between its BE and SE stages, the KeTT helps users identify, visualize, and interpret social relationships at varying scales while retaining a high level of detail (Lafreniere and Gilliland 2015, 2018). Exploring people and social networks in context enhances both the accessibility and usefulness of the historical record to the public by digitally linking physically separated datasets and making them searchable, either through virtual spatial exploration or keyword searches. Representing a place of interest to many family researchers around North America, the KeTT provides access to this data to those not able to make an in-person visit to the archival repositories in the region.

The social connections made possible through the KeTT have become increasingly evident in the project's public programming. During summer 2017, teams of undergraduate and graduate students took KeTT to 19 outdoor festivals and events that attracted locals as well as tourists (Scarlett et al.

2018). In virtually every form of public interaction, during both the design phase of the KeTT software and subsequent outreach activities, the most common questions were about an ancestor or specific person from the past. The rapid expansion of the Copper Country's population during the mining era was driven by the recruitment of immigrant labour. The initial wave of immigrants included Cornish, German, and French-Canadian migrants. Subsequent waves included Italian, Eastern European, and especially Finnish immigrant groups (Lankton 1991). Public interactions with the KeTT very often begin with the investigation of an immigrant ancestor's settlement in the Copper Country. Once they explained its capabilities, students inevitably heard questions about a person's family name or place with social connections. Comments on social media frequently offer stories about a specific family member or inquire about their places of residence or other relatives who used to live in the Keweenaw. Stories uploaded in the Explore App range from accounts of skirmishes that took place during the 1913 strike, to descriptions and photos of long-demolished commercial buildings, to memories shared by MTU alumni of university life in the past. While archaeologists or heritage professionals often focus their research at a particular site, most community members start with social connections. The KeTT can thus serve as a way for researchers and the public to access the same vast body of information about the past despite approaching it from different directions. Ultimately, the KeTT makes the past social landscapes of the Copper Country more visible and highlights the links between past communities and our own.

Political

In constructing the KeTT, we explicitly wished to avoid creating a single heritage narrative of the Copper Country and simply presenting it to the community or limiting community involvement to passive roles. We see the challenge of fostering recognizable multivocal and occasionally dissonant heritage making in our postindustrial landscape as a political challenge, and to meet it we must engage with the public in ways that are genuinely interactive. The KeTT interface, coupled with the team's outreach programme, is explicitly designed to foster easy access to and interaction with a massive amount of historical spatial big data that supports expert research and public heritage making exist together within a multiply constituted digital representation of the postindustrial heritage landscape.

Achieving this requires a combination of the KeTT software and a series of complementary engagement activities (Figure 6). We draw on the research of community archaeologists and heritage scholars whose work has gained increased energy in the academy as scholars across multiple disciplines have embraced community-engaged scholarship (Waterton and Watson 2011; Richardson and Almansa-Sánchez 2015). We use a combination of HGIS approaches, social media, and in-person programming to implement a public practice that enables individuals with diverse life experiences to find 'a way in' to exploring material and spatial remnants of the past that informs and generates new meanings for the present and future (Harner, Knapp, and Davis-Witherow 2017).

The KeTT and the CC-HSDI aim at fostering multivocality, yet the understanding among researchers that the social process of making material and spatial meaning is never uniform, nor universal, but rather multiple and overlapping can be opaque to the public (Massey 1994; Smith 2006). At public events, many community members ask how we ensure 'accuracy' in the user contributed stories; our explanation that the past can be seen from a variety of differing perspectives often clashes with a public that received a history education based on problematic single-narrative models of history (McCully 2012; Rosa 2012). Though there is no simple answer to this challenge, The KeTT contextualizes user-submitted stories within a vast body of historical records from the archives (which can themselves offer conflicting perspectives on the past), and this transparent juxtaposition is intended to help steep the public in the multiple voices and overlapping, occasionally conflicting narratives of the region's past and present. In this context, contemporary heritage place making can be seen as part of a continuous cultural process that stretches back far into the region's past. Rather than simply asserting to people that history is multivocal, we present people with a huge body of



Figure 6. The KeTT project has increasingly made use of GPS-enabled tablets to enhance public-expert collaborative activities. (Photo: Keweenaw Time Traveler, Michigan Technological University).

historical data containing thousands of personal histories, each with its own perspective, to which the contemporary community may add its own memories and stories. Exploring this digital space exposes the diversity of lived experience across time and space in the Copper Country to the public eye.

Discussion: Ongoing challenges

Since its launch in summer 2016, the Keweenaw Time Traveler project has generated a substantial amount of interest in the community we intend to serve. Roughly 900 people have interacted with team members at various community events over the last two years. The team constructed two touchscreen kiosks running the KeTT web interface that allowed the public to learn to use the software and provide feedback to the KeTT team members. The KeTT's Facebook³ and Twitter⁴ pages have generated spikes in traffic to the KeTT project site through topical posts relating to holidays, or the highlighting of specific places and stories, as well as notifying the community of upcoming public engagement activities. The public also contributed a substantial amount of data to the KeTT using the builder apps: 188,742 unique building material classifications, 93,109 unique building use classifications, 6,779 unique map transcriptions, and 630 stories shared (Figure 7).

The KeTT has had a promising start. As the project evolves, we remain focused on addressing ongoing challenges inherent in this kind of publicly engaged work. To begin with, we acknowledge that the project originated in the academy, among an interdisciplinary research team, rather than as a grassroots movement within the community. The first phase of our project was therefore focused on introducing the concept of PPHGIS, and its potential value to heritage-making, to the local community. The community response to this initial stage of the project has been overwhelmingly positive. Since then we have focused on growing this participation further with each new phase of the project, both in terms of sheer numbers of participants and connecting to new segments of the community.

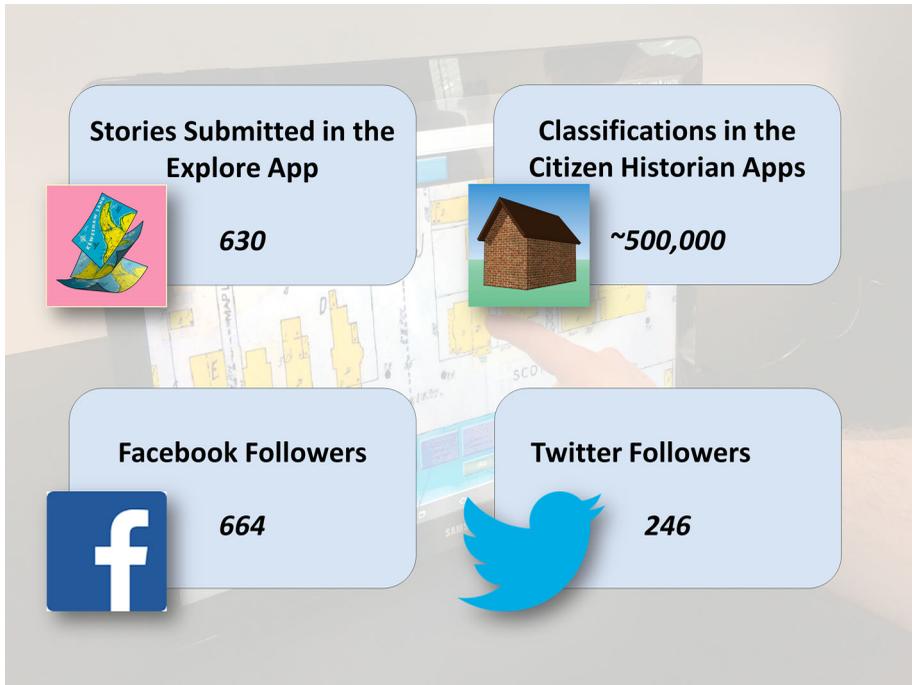


Figure 7. Public interactions with the Keweenaw Time Traveler Project. (Illustration: Keweenaw Time Traveler, Michigan Technological University).

Within this context, we must take seriously our responsibility to configure the project in ways that will facilitate the addition of stories from underrepresented groups and help redress the historical silencing of their experiences and viewpoints. Unless we can do this, we risk repeating the historical biases we know to be inherent in some of the historical data that constitutes the CC-HSDI. Local indigenous communities represent an obvious example of an underrepresented group whose identity forms an integral component of the broader Copper Country heritage landscape. Native Americans have lived in the Copper Country for thousands of years and, of course, are the first and longest-enduring users of copper in the region. They remain a significant segment of the regional population, and we acknowledge that the KeTT project has only just begun to address the historical biases in this area that form part of the regional authorized heritage discourse (Smith 2006, 4–5).

In the Copper Country, as with so many regions with colonial histories, the story involves significant displacement of indigenous communities. The three counties included in this HSDI incorporate land ceded in the Treaty of 1842, a fact acknowledged on the project's 'About' page. The addition of resources that could help foreground Native American histories in the KeTT would highlight the legacies of colonization and the challenges of counteracting it. Unilateral efforts to make indigenous people more visible, however, bring risks. For example, if the 1845 General Land Office maps from the US Government's first official survey of the region were made publicly available in the KeTT web apps, some locations denoted as sacred to Native American groups might be exposed to increased vandalism or threatened safety. Likewise, Native American pre-contact copper mining sites could become increased targets for looting if their locations were more easily identifiable – a challenge familiar to any archaeologist. While a map-based tool of this sort will never be entirely free of a European-derived view of land ownership, the voices of residents who tell Native American stories, and include Ojibwe perspectives, would contribute to the process of decolonizing the heritage of this region. The KeTT research team are currently working with MTU's directorship of

university-indigenous community partnerships to foster collaboration with the indigenous community, and to explore ways native knowledge may be better incorporated into the CC-HSDI and KeTT.

A second ongoing challenge to the project is achieving effective engagement with a community that may not be receptive to government-funded projects led by experts without multi-generational roots in the community. As a project based at a state university, jump-started with funds from the National Endowment for the Humanities, the KeTT remains situated within Western traditions that prioritize expert knowledge and sanctioned professional practice. In addition, few of the student team members have long-term ties to the community. When taking in a community's heritage values, heritage experts may sometimes overlook groups not typically described as disenfranchised, but who nevertheless identify as being misrepresented by broader society. In the Copper Country the identities of the groups who feel disenfranchised may differ somewhat from in other parts of the country. Among rural, white, postindustrial American communities suspicions and anger towards expert-led institutions is a real phenomenon (Hochschild 2018). Today, the population of the Copper Country is over 90% white and economically disadvantaged; while the MTU campus is more diverse than the community as a whole, the numbers are still small and tend to include international scholars more than racially diverse Americans.⁵ In other words, many long-term Copper Country residents, whose participation is vital to the success of the KeTT, may consider themselves among the 'forgotten' rural white working class whose intense feelings of disenfranchisement are often linked with the election of President Donald Trump in November 2016 (Davies 2018). Indeed, all three of the counties included in this project voted for Trump by more than 50% (Michigan Department of State 2016). Thus, a majority of our community possesses a political worldview that is associated with a distrust of intellectuals and the broader scientific community (Motta 2018). This places the KeTT team, as academic researchers without deep familial roots in the area, at risk of being cast as outsiders with an agenda that is at best not in tune with the needs of the local community, or at worst actively undermining it.

The KeTT project instigates locally focused conversations on heritage among groups who may not otherwise have meaningful relationships. For us, the ongoing challenge is to demonstrate that our federally funded, university-based HSDI and web apps serve the community in meaningful ways. Cooperatively exploring a mutual interest in place is a logical starting point for building mutual trust and recognition. To people having a conversation over the KeTT about favourite swimming holes, remembering old restaurants, or comparing their aging uncles' old stories about the last days of the mines, the act of talking may not seem political. But in today's increasingly polarized world, talking with neighbours to create place-based heritage may be among the most political acts of our age.

Our approach to these challenges is based upon iteratively applying our charrette based collaborative discussions with the community on the design and use of the KeTT software. We will continue to grow our user base through ongoing work with our community partner organizations and the KeTT team's continued presence on social media and in person at public festivals. Upcoming better user interface design and data visualization options resulting from our collaboration with the public and community partners will improve accessibility, promote more robust spatio-temporal queries, and overall user experience. The initial versions of the KeTT interface were designed by team members with modest experience in web design; our next proposed round of funding includes the recruitment of a dedicated interface design professional, with expertise in historical spatial data, who will substantially upgrade the interface and enhance both its usability and visual appeal.

Conclusion

Postindustrial heritage landscapes remain dauntingly complex stages for engagement among archaeologists, heritage scholars, and the public. Nevertheless, as recent critical scholarship on such places argues, it is in precisely within such challenging contexts that practical, effective engagement is most needed (Baird 2017). We believe that digital, participatory GIS-based approaches to

collaboratively visualizing and exploring landscapes and communities, past and present, can support a broad-based interdisciplinary scholarship that is also truly engaged with local communities. We have focused on how archaeologists and heritage specialists can use our CC-HSDI, but our team also is composed of specialists in history, geography, GIS, and computer science. Collectively the team created something that is greater than the sum of its disciplinary parts. From the beginning, our team has set the development of a meaningful collaborative relationship with the community as a crucial goal for the project. While we do face ongoing challenges in making and maintaining the KeTT as a truly community-driven heritage making digital environment, the initial results have been promising. Our approach can be summed up as a recursive process of asking the community what they need or want in a digital heritage platform; using our interdisciplinary expertise to develop those desired features while observing the best practices of our respective disciplines; and then returning to the community for feedback and improvements. This is an open-ended process that will never be 'finished' but will continue to respond to the evolving needs of the community and its heritage values.

The KeTT is as much a way to link people and help them work collaboratively as it is a repository of information and a novel means to explore and visualize that information. In terms of identifying our role in the process of heritage making in the Copper Country fostering this collaboration is easily as important as academic knowledge production and methodological innovation. In our role as experts, we must make our expertise available in ways that serve the postindustrial communities we study, and to mitigate, rather than accelerate, those physical, social, and political forces that threaten them and the heritage landscape they occupy.

Notes

1. Derived from urban planning (Lennertz and Lutzenhiser 2006), the charrette is a focus group-based approach to design that the KeTT team adapted as a way to involve the community in guiding the development of KeTT's web interface and choice of datasets.
2. <https://www.nps.gov/kewe/learn/education/classrooms/what-is-copper-traces.htm>
3. <https://www.facebook.com/KeweenawTimeTraveler>
4. <https://twitter.com/KeweenawHistory>
5. United States Census Quick Facts, Houghton County (<https://www.census.gov/quickfacts/fact/table/houghtoncountymichigan/PST045216>), Keweenaw County (<https://www.census.gov/quickfacts/fact/table/keweenawcountymichigan/PST045216>), Ontonagon County (<https://www.census.gov/quickfacts/fact/table/ontonagoncountymichigan/PST045216>). Accessed May 14, 2018.

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