CHAPTER 6

Collaborative editing of sixteenth century Indigenous graphic manuscripts from Central Mexico

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Abstract

Understanding the messaging of an Indigenous graphic manuscript from early colonial Central Mexico requires the accumulation and amplification of many voices. Restricting interpretation to a single expert or academic discipline, without the input of descendant communities for whom these objects held and hold significant valency, stifles the communicative potential of such manuscripts. This chapter highlights a collaborative, replicable, flexible, and linkable solution to presenting such objects online to an open audience of users: the CITE Architecture. This chapter begins with a brief overview of this Indigenous

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manuscript painting tradition, demonstrating its unique challenges to reading, interpreting, and citing its narrative structures. It then demonstrates how producing collaborative editing frameworks is necessary to caption, interpret, and link information to visual documents such as the objects in question. It then introduces how an existing solution—the CITE Architecture—can be leveraged to facilitate new collaborations between scholars and Indigenous communities for whom these manuscripts hold living meaning.

Nahuatl by Abelardo de la Cruz de la Cruz, Chicontepec de Tejada, Veracruz

Hueli mocuamachiliz tlen quihtoznequi ce macehualixcopincayotl tlen Mexcotlalli tlen ipehuayan caxtolli huan ce hueyixihuicahuitl monequi oncaz huan mopazoloz miac tlahtolli.

Tlan zan ce acahya zo ce tlamachtiliztli quichihuaz ni tequitl, huan tlan macehualmen tlen naman axcanah tlapalehuizceh, huan ni ixcopincayotl nochipa quipixtihualtoc ipatiuh, quiixtzacua iquihtoznequiliz ica nochi ni amatlahcuilolli.

Ni tequitl quipannextia ce tlamapalehuiliztli, hueli quichihuaz ceyoc, amo ohuih, huan mohuicaltia para mopannextiz pan tepoztlamahuizolli tlen motequihuiah naman: Arquitectura CITE.

Ni amatequitl pehua ica ce tlacuamachiliztli ica queniuhqui mochiuhtihualtoc macehualixcopincayotl, campa quipannextia ohuihcayotl para ce quipohuaz, quicuamachiliz huan quimatiz cualli queniuhqui moxeloa tlahtolli.

Teipan mopannextia queniuhqui monequi mochihchihuaz tequitl para tlahcuilolli, mocuamachiliz huan mohuicaltiz tlamatiliztli ica amaixcopincayotl.

Teipan monextia queniuhqui hueli motequihuiz, ni Arquitectura CITE, para mochihuaz yancuic tequitl ica coyotlamachtianih huan macehualaltepetzitzin tlen ininaxca ni amatlahcuilolli huan quipiyah hueyi ipatiuh naman tonatiuh.

Nahuatl by Gaby Citlahua Zepahua, Tequila, Veracruz

Kampa ma moyekmati se tlahkuilolneskayotl masewal tlen opankiskih itlahkotipan Mexihko tlalnantli ihkuak yekintzin oahsikoyah pinomeh, moneki, ma molochokan iwan ma mokalakikan tlatlamantli tlahtolmeh.

Tla san se ixtlamatke noso san se temachtilistli moaxkatilis nin yekmatilistli noso tlahtolkuepalistli, iwan amo kitlakamatis itlachialis masewalaltepemeh tlen ich walkisah, akinmeh melahka kiyekmatiwitzeh nin tlatlamanyotl, kiehtlakowa iwan kiaxkayotia iteixpantilis inin tlahkuilolli.

Inin tlahkuilolli kiyektenewa se sekantlachiwalli, tlen kualtis oksekan mochiwas, tlen kualtis san akin kinehnekis iwan noihki motexpantihtos noso tesalohtos kampa ma monextikan nin tlatlamanyotl kampa ma kittakah san akin: Tekalchihyehyekolistli CITE.

Inin tlahkuilolli pewa kampa kiteixpantia san yehyektzin kenin yiwehkika mochihtiwitz non masewal tlahkuilolneskayotl iwan kinextia iowihkayo kampa ma moamapowa iwan ma motlahtolkuepa, noihki kenin moneki momehtoltis noso ipan motlahtos kenin machiohtiwitz.

Noihki ihkon, kinextia kenin moyektlalia sekan kanin kualtis motlahkuilos tlen motlahtowa, noihki kampa ma motlahtolkuepa iwan ma mo panoltili tlhkuilolli, noso tlatehyekolli ich okse amatepostlahkuillolli ipan uñinin tlatlamanyotl.

Nimantzin, kiteixpantia kenin kualtis monehnekis inin tlapalewilistli tlen yi kahki Tekalchihyehyekolistli CITE, kampa ma mopalewi olocholistli ipan tleyehyekoltlahkuilowani inawak masewalaltepemeh akinmeh ipampa ininkeh tlahkuilolneskayomeh ok moyolitihtokeh.

Spanish by Elizabeth Baquedano

Entender el mensaje de un manuscrito gráfico indígena del México central colonial temprano requiere, la acumulación e inclusión de muchas voces. Restringir la interpretación a un solo experto o disciplina académica, sin el aporte de las comunidades descendientes para quienes estos objetos tenían y tienen un valor significativo, restringe el potencial comunicativo de tales manuscritos. Este capítulo destaca una solución colaborativa, replicable, flexible y de vinculación para presentar tales objetos en línea a un público abierto de usuarios: la Arquitectura CITE. Este capítulo comienza con una breve descripción de esta tradición de manuscritos indígenas y demuestra los retos únicos para su lectura e interpretación, así como para citar y explicar sus estructuras narrativas. Así mismo, demuestra cómo produciendo marcos de trabajo de edición colaborativa para subtítulos, así como para interpretar y vincular información a documentos visuales como los objetos en cuestión. Posteriormente se presenta cómo se puede aprovechar una solución existente, la Arquitectura CITE, para facilitar nuevas colaboraciones entre académicos y comunidades indígenas para quienes estos manuscritos tienen un significado vivo.

1. Indigenous Graphic Manuscripts

Many centuries before the Spanish invaded what is now the nation-state of Mexico, Indigenous makers across time and space encoded information on a variety of supports including *amatl* paper and animal hide, employing conventionalized semasiographic and glottographic communication systems (Boone & Urton 2011; Mikulska & Offner 2019).[1] Works on paper

[1] The authors would like to thank Patricia Murrieta-Flores for her generous contributions to this chapter.

and hide often took the form of accordion-style books, and contained divinatory, historical, and calendrical information with Indigenous, rather than Western, categorical boundaries. In the wake of the Spanish Invasion of 1519, nearly all pre-Hispanic books and manuscripts were destroyed or lost, although fourteen survive today. Despite this large-scale destruction, the manuscript-making tradition did not end in 1519, but instead proliferated in the early colonial period, often in response to the challenges of the new legal system imposed by the Spanish, but also for the internal needs of Indigenous communities.

Today very few such manuscripts remain in the possession of living communities. One example is the Tlalamatl Cuaxicalan ("Land Paper of Cuaxicala" in Nahuatl), held for four and one-half centuries by the town of Cuaxicala, to the east-northeast of Mexico City (Figure 6.1). This five-meter-long manuscript, painted on animal skin, divided into twenty-four sections, and executed in the graphic non-alphabetic Aztec style, tells the history of the surrounding region, including two more powerful neighboring cities expelling rival Huastecs in previous centuries. The manuscript includes Nahuatl-based glyphs and notation specifying personages, geographic locations, and dates, although at least one glyph can be read in two additional languages, Totonac and Otomi (Stresser-Péan 1995; Offner 2010). Alphabetic annotations in Nahuatl were added at least once in the late seventeenth century and perhaps later by members of the community to repurpose it as a boundary statement for their community in colonial legal struggles with neighboring communities (Offner 2021a). The manuscript continues to be a "living document", celebrated and consulted by this community as a touchstone of identity. After a campaign initiated and led by the community, it was recognized as a "Memoria del Mundo México" in 2018 by UNESCO Mexico, the first time that it had recognized an artifact held by a living community rather than by a cultural institution. Even before UNESCO recognition, the town had a long history of people interpreting their manuscript, with notes on copies of it more than four inches thick observed by Offner in 2019.

In 2019, the local school produced a sophisticated map of their community, based on the alphabetic glosses in Nahuatl added to the manuscript in 1698 and conventional colonial legal records, including several pages of Nahuatl brought to light by Sr. Nabor Garcia, a former official of the town at the time of the UNESCO recognition (Figure 6.2 is a recent iteration). Research recently presented by Offner (2021a), on behalf of longstanding friends of Cuaxicala, Guillermo Garrido Cruz and the late Nohemí Leticia Ánimas Vargas, provides numerous examples of improvements in understanding of the manuscript through direct engagement with the community (cf. Offner 2010). Key community figures have also voluntarily permitted recorded video and audio interviews in Nahuatl and Spanish providing their thoughts on growing up with such an extraordinary manuscript in their community.[2] The additional insights already

[2] The video interviews are in several private hands as are the later audio interviews, with plans to archive them in an online repository in the coming few years.

Figure 6.1: Section 10 of twenty-four graphic sections of the five-meter long Cuaxicala manuscript on animal skin known as the Tlalamatl Cuaxicalan or Códice de Cuaxicala. Nahuas from two cities in the region expel Huastecs from their fortified site of Tuzapan. Three dates when this happened are shown in Indigenous notation in the upper left. Courtesy: Comunidad de Cuaxicala, Guy and Claude Stresser-Péan.

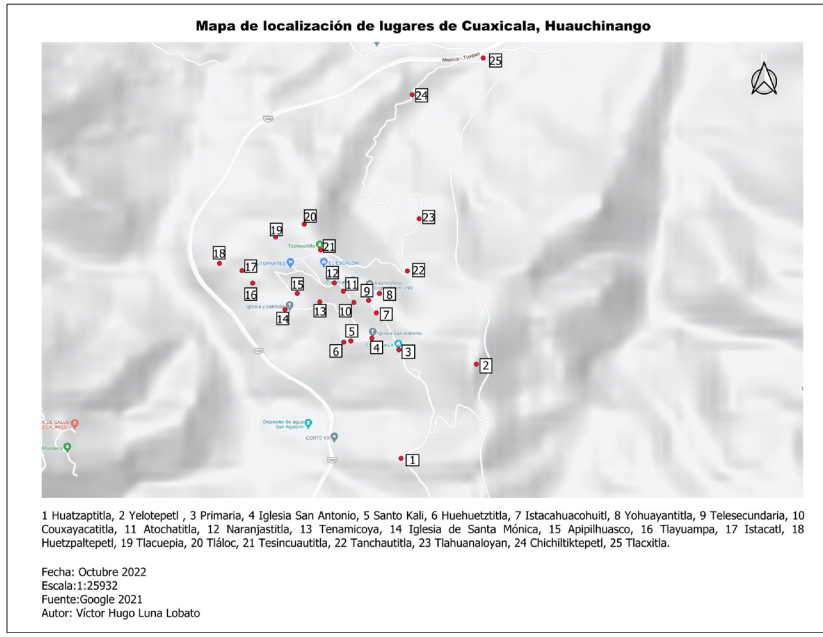

Figure 6.2: Digital map of Cuaxicala produced by and courtesy of Victor Hugo Luna Lobato.

obtained directly benefit anthropology, archaeology, art history, history, and other fields of study (Garrido Cruz, Animas Vergas & Offner, forthcoming).

Another group of manuscripts in the graphic Aztec style, the *Papers of Itzcuintepec* is held by the British Museum (Figure 6.3).[3] While no longer *in situ*,

Figure 6.3: Part of the Papers of *Itzcuintepec*, Egerton 2897(2). Courtesy British Museum. https://www.britishmuseum.org/collection/object/E_Am2006-Drg-2897.

[3] See https://www.britishmuseum.org/collection/object/E_Am2006-Drg-2897, and https://www.britishmuseum.org/collection/object/E_Am2006-Drg-2896. Oudijk (2009) proposes they come from the Huauchinango region and references and evaluates earlier work by Brotherston and Berger. A later work by Ortiz Arroyo (2010) seeks incorrectly to localize these manuscripts in Oaxaca. Offner (2012) localized them more precisely in the area of Xolotla

these documents have begun to play a similar role for the nearby communities of Xolotla and Metztla, as Garrido Cruz reports intense interest from the people of Xolotla in viewing and understanding their past as depicted in these documents.

Although a few Mexican Indigenous manuscripts remain in their original communities, many others are held in museums and libraries across the Atlantic. The provenance histories of such manuscripts are varied and often fraught with colonial circumstances. The Bibliothèque nationale de France now holds the Codex Xolotl, which is well outside of its original context, the eastern Basin of Mexico (Dibble 1951; Offner 2021b). It is a group of similar documents that recount several centuries of Aztec history ending about ninety years *before* the Spanish invasion, executed in Indigenous and non-alphabetic form, according to expert, but non-Western, historiographic conventions (Figure 6.4). Over the

Figure 6.4: Codex Xolotl, page 2, ca. 1540s, carbon black ink and other pigments on *amatl* paper, 42 x 48 cm. Bibliothèque nationale de France, Mexicain 2.

and Metztla-Copila, Huauchinango, Puebla. Garrido Cruz and Offner have been conducting research "on the ground" in this area recently and hope to publish their findings in the coming years.

course of ten pages and three fragments of Indigenous *amatl* paper, it displays hundreds of scenes of precontact history. It records several centuries of histories and stories culminating in about 1431. It begins *in medias res* tracing a Chichimec migratory group, helmed by its first ruler Xolotl (the manuscript's namesake), as they enter the Basin of Mexico.

Within the *Xolotl*'s pages, we learn how some of these gathering and hunting groups become acculturated to sedentary, agricultural practices. The narrative goes on to record the intermarriages and acculturation among many of the groups that ultimately coalesce as the Aztec Empire at the time of European contact. Marriages, births, deaths, as well as both community and individual tales of conflict, concordance, heroism, avarice, cowardice, good, and evil play out as scores of characters swarm over the densely-packed, interrelated leaves of this engaging series of compositions.

The *Xolotl* is unusual in the corpus of Mesoamerican manuscripts because of its iterative cartographic organizational framework; over the course of nine of the ten pages, its makers arranged the historical narrative with regional maps of the Basin of Mexico. Thus, the map-histories of the *Xolotl* present complex historical and geographical information from a uniquely Indigenous perspective.

Understanding the *Xolotl*'s complex narrative requires an acknowledgement of its geographic armature and the nature of its reading practices. The Xolotl's spatial framework, which presents the historical narrative of each page simultaneously, means the reader approaches all the content synchronously; there is no single reading order, as multiple perspectives exist contemporaneously within and between pages. Portions of the story may be read or orated, depending on the needs or circumstances of the intended audience, and narrative threads across the page(s) could be tailored and tied together or neglected, depending on the intention of the orator.

This fact has largely been ignored by scholars who have interpreted the Codex Xolotl. The Xolotl's role as a prime source of the precontact past has made many want to dive into its narrative, interpreting it into linear, alphabetic prose to which Western, scholarly writing is confined. This inclination is not novel, since a few hundred pages of Spanish and Nahuatl texts survive from the sixteenth and early seventeenth centuries (including Fernando de Alva Ixtlilxochitl's *Obras históricas* [1975], Juan de Torquemada's *Monarquía Indiana* [1969], a Nahuatl source known as the *Anónimo Mexicano* [2005], and *Anales de Cuauhtitlan* [Bierhorst 1992a, b]) that use the Codex Xolotl (among other graphic manuscripts) as source material, but they only succeed in describing some aspects of its content and meaning.

Given the tension between an overarching map-like framework and the individual strands of narrative that can be pulled out of a given page, the *Xolotl*'s historical narrative challenges traditional assumptions about interpreting, editing, and publishing this manuscript. The *Codex Xolotl*, taken together with the colonial texts that report on it, constitute the ideal laboratory for the collaborative interpretation of Indigenous texts that privileges how these manuscripts

were intended to be read: via multiple voices and agendas. It is a manuscript that speaks to the scholarly concerns of a multidisciplinary audience. Its large collection of glyphs, including the longest strings of Aztec language glyphs, fascinates linguists and students of writing, while its complex semasiography challenges and informs investigators of indigenous artistic expression and practice.

The holding institution of the *Codex Xolotl* has done an excellent job of curating and presenting the manuscripts in electronic form for visual inspection by an English-speaking audience, within accepted expectations of professional museum exhibitions, while the town of Cuaxicala has not been able to afford its own online presentation for its manuscript. Moreover, broadly speaking, silos exist between the institutions that steward these (and other) graphic manuscripts and the communities from which they originate. It would be ideal to go beyond this creditable stage of conventional, Western exhibition of such artifacts to a new stage of curated, collaborative, evolving, online presentation in languages accessible to the communities indelibly linked to them. This would require supporting relationships with these communities in order to cultivate new pathways and infrastructures of scholarly contributions to the study of such manuscripts. It would present certain challenges for editing, data-management, and would certainly require a re-thinking of "citation" both in the technological sense of "how to connect information together" and in the human sense of "how to give credit and assert authority for insights and ideas."

2. Challenges of Digitally Editing Mesoamerican Manuscripts

The obvious first steps towards preparing digital editions of these manuscripts are the preparation of catalogs of personages, locations, glyphs, and scenes, defined as labeled regions-of-interest on page images. Because "scenes" on the manuscripts often consist of smaller scenes, and because "scenes" are matters of scholarly assertion and may therefore be contentious, no edition of these texts can expect to be definitive but will represent one moment in an ongoing conversation about the meaning of the manuscript.

In fact, the sixteenth and seventeenth century Spanish and Nahuatl texts narrating the history of the hero Xolotl, based on manuscript evidence, represent the first voices in that conversation, and would be the basis for an initial body of image-aligned commentary.

These manuscripts are an open-world problem, as they treat mythology, history, and geography. Because they challenge modern assumptions and conventions of narrative (given the push-pull between the totality and the detail of each page), they are not well suited to any data organization that depends on a predefined schema or that places restrictions on overlapping hierarchies (as XML does).

Furthermore, these manuscripts are living documents, actively participating in the communities, both Indigenous and academic, that have possessed them

for centuries. When living communities are involved, it would be presumptuous for any professional scholars to "edit" these artifacts, making positive assertions, without at least giving equal voice to the people whose communities, history, and identity are based on these documents. When, inevitably, scholarly understanding may conflict with local understanding on some points of interpretation, the utmost delicacy will be necessary. Of course, scholars edit texts that are important to communities or faith-groups all the time, and propose new understandings of history that differ, for example, from the Vulgate. With these Mesoamerican texts, however, the potential disparity of wealth and power, and the history and even current relationships between the Spanish and Indigenous language speakers of Mexico, not to mention the United States, the United Kingdom, and Europe, amplify the ethical considerations. Furthermore, for a digital project, issues of wealth and access to technology come to the fore via questions of who can contribute to an editorial project focused on these texts, and who will profit from that project.

To take the *Codex Xolotl*, for example, the manuscript has always presented challenges for publication, analysis, and presentation, prompting the need for a new solution. The undisputed starting point for analysis is the print publication by the American Charles Dibble (1951), whose exceptional book included high quality black and white photographs of the *Codex Xolotl*, expert commentary, analytical indices, genealogy, a study of chronology and a bibliography. While vital to any student of the *Xolotl*, Dibble's reliance on earlier historians' interpretations betrays its limitations.

In terms of digital projects, beginning in 1994 and based on the program Windev, France's Marc Thouvenot pioneered electronic presentation of *Codex Xolotl*, and indeed, many Mesoamerican graphic manuscripts, with his program Tlachia, using 72 and later 300 dpi visible light images and a robust method of glyphic analysis. Complemented by an available PDF version of his 1987 dissertation, he created downloadable catalog files of the Codex Xolotl and other graphic manuscripts that were made available at SUP-INFOR.[4] These have since been put online in a browser-based edition, as a part of a revamped platform called the Compendio Enciclopédico Náhuatl (CEN), which has fixed many of the issues of the original Tlachia program (which did not run on Apple devices and had user-generated installation issues on PCs).[5] Care has been taken to make CEN available on smartphones, a device available to more people than computers and increasingly flexible search capabilities have been added. Unfortunate intradisciplinary doctrinal divisions over methods for Aztec glyphic analysis and antipathy to the method developed by the Mexican scholar Joaquín Galarza and used, in adapted form, for Tlachia, have sharply reduced its use (Oudijk

[4] http://www.sup-infor.com/.

[5] https://cen.sup-infor.com/home/tlachia. CEN is available at: https://cen.sup-infor.com/home/hellow.

2008). However, Thouvenot's body of work in glyphic decipherment, although necessarily Procrustean and often decontextualized, remains unmatched in breadth and accuracy. Overall, Thouvenot's Tlachia remains underutilized and underappreciated outside of France and Mexico, but the authors nonetheless find it indispensable for study of the *Codex Xolotl*.

Beyond the *Xolotl*, additional high-quality pioneering work in Mesoamerican digital humanities has been led by Stephanie Wood with the online Nahuatl (Aztec language) dictionary.[6] This Drupal-based site is searchable using open methods, linguistically-informed methods, and a developing list of preset themes. It is an indispensable tool for the study of Nahuatl, along with the Gran Diccionario Náhuatl (GDN), an older, more comprehensive, less flexible, but searchable compilation of four centuries of dictionaries developed by Sybille de Pury and Marc Thouvenot (also now integrated into Thouvenot's CEN). None of these, however, contains images or glyphs. Graphic manuscripts are presented in high-definition visible light images in Wood's "The Mapas Project", again using Drupal.[7] On this site, areas per page are "clickable" to bring up brief commentary on the specific area. As with Thouvenot, we hold Wood's work in high regard.

Another early effort to share digital copies and translations of Mesoamerican manuscripts, largely based on Thouvenot's program and work, is Amoxcalli, spearheaded by Luz María Mohar Betancourt in 1999.[8] It also uses 72 dpi visual light images linked to commentary of each manuscript. However, currently, there is no ability to see text and commentary on a single webpage and it is not interactive beyond clicking through set menus.

In recent years, there are excellent online editions of single Mesoamerican manuscripts, such as the Codex Mendoza and the Lienzo de Tlaxcala. Both of these feature a user-friendly presentation of high definition images of a manuscript with a promise, not yet realized, of interactivity and further content development.[9] In the former, the ability to mouse over sections of the Spanish text on the manuscript to bring up an easily-read Spanish transcription is a notable feature, but other aspects, such as mapping of toponyms, are undeveloped.

For non-alphabetic manuscripts, such as the aforementioned manuscripts, where the *images* must be central, any analysis of them is inevitably controversial, or at least multivalent (with professional scholarly and historical perspectives not necessarily aligning with the received understanding of the communities that own the manuscripts). A "multi-textual" approach is most

[6] https://nahuatl.uoregon.edu/.

[7] https://mapas.uoregon.edu/.

[8] https://amoxcalli.org.mx/.

[9] https://codicemendoza.inah.gob.mx/inicio.php?lang=english; https://lienzodetlaxcala.unam.mx/lamina-0-alegoria/.

appropriate, which allows the relation of graphic images to each other without the interference of alphabetic text, while preserving and enhancing the ability to summon up alphabetic sources that are dependent on the graphic surface, along with later critical commentaries (explanations, analyses, stories). This will place the graphic material in the center of perception, appreciation and analysis, where it has always belonged. In so doing, we believe that realizing an accelerated understanding and sharing of the original indigenous perception of these works, and their ways of recounting their history, religion, and other vital cultural knowledge, must be at the center of future digital presentations of Mesoamerican manuscripts.

3. The CITE Architecture

Our proposed solution to the problem we have outlined above is to leverage an existing digital framework to Mesoamerican manuscripts: the CITE Architecture. "CITE" is an acronym for "Collections, Indices, Texts, and Extensions" (Smith & Blackwell 2012). It is a collection of tools and techniques for organizing and working with an open-ended and diverse body of scholarly data (Blackwell & Smith 2019).

CITE was developed to support a specific project, the "Homer Multitext" (HMT), a project of the Center for Hellenic Studies of Harvard University. Its Editors are Casey Dué and Mary Ebbott. The mission of the HMT is to produce 21st Century editions of the primary source texts for Greek Epic poetry, the *Iliad* and the *Odyssey*. In contrast to the tradition of critical editing, in which the editors seek to reduce a varies manuscript tradition to a single authoritative text, the HMT aims to preserve the variation found in the transmission of Homeric epic, variants in the text found in Byzantine manuscripts and earlier papyri, as well as variants mentioned in the tens of thousands of ancient scholarly comments, the *scholia*, that date back to the writings of the earliest scholars working in the Library of Alexandria. This project, then, presented a challenge of "scholarly identity"—multiple texts that all instantiate a notional *Iliad*, in whole or in part, that are to be aligned and compared, but with no "base text" given priority.

Since 2006, the HMT has produced editions of several deluxe codices of the *Iliad* with commentary, beginning with the 10th Century Venetus A (*Marcianus Graecus* Z.454). This data is archived on GitHub and freely available.[10] In parallel with this ongoing work of editing, the HMT developed code-libraries to support the project. The humanities problems that framed these libraries were: "How can we organize and align many different versions of the same text (as critical editions have always done) but without privileging any one version

[10] The HomerMultitext Archive: https://github.com/homermultitext/hmt-archive.

(unlike what critical editions do)?" And also, "How can we allow scholars to document coherent narratives when a narrative might skip from text to text?" For example, the story of a Homeric hero, like Patroclus or Odysseus' sister, might never appear as a single "story" in the epic poetry. But from a passing mention in the *Iliad*, a particular adjective in the Odyssey, a scholarly comment on one manuscript, an intra-linear gloss in another manuscript, we can reconstruct a mythological story.

The **data model** that has emerged over twenty years of development is very straightforward: in plain-text, a series of pairings of URN-formatted identifiers with some data, whether that be a passage of text, a data-record, or metadata identifying a binary image. A complex digital library can be serialized into a single plain-text file following the CEX ("CITE Exchange") format.[11]

CITE is, at heart, mainly a scheme by which any object of scholarly study, concrete or abstract, can be identified with a unique identifier that (a) depends on no specific technology, working as well in print as in a digital environment, (b) identifies the context of the object as well as the object itself. The rest of CITE are tools that work with the data identified in this way. CITE has always complemented standards like IIIF (for images), TEI-XML (for texts), and relational database systems. The advantage of CITE is that it allows data to move freely across technologies and formats, since it is not limited to any particular technology. Over the years, the HMT's data has been in XML, RDF, RDBs, and implemented in Perl, C++, Javascript, Python, Go, XSLT, and Java. The current reference implementation is in Scala, with versions of the core libraries under development in the Julia language.

For an open-world project like editing and commenting on the Codex Xolotl, a clean separation of concerns—texts, images, comments, geo-spatial data, back-end storage, end-user applications—is most desirable. With the CITE Architecture, it should be possible to implement a rigorous separation of concerns. A Spanish translation of a seventeenth-century commentary should be just that, a text; it should exist independently of a manuscript-image (for example) while being aligned with it; the image, the text, and the alignment should all stand alone. CITE lets each kind of data exist in its own right and uses canonical citation to integrate them for either functionality or analysis or display. Users always retain the ability to go to the primary data and re-use it in novel combinations.

Large scholarly digital libraries recognize the value afforded by CITE. Brill Scholarly Editions, for example, uses the CITE Architecture for its TEI-XML based collection of edited texts.[12] Likewise, Das Deutsches Textarchiv,[13] and

[11] CEX format: https://cite-architecture.github.io/citedx/CEX-spec-3.0.1/.

[12] https://dh.brill.com/scholarlyeditions/about/.

[13] Berlin-Brandenburgische Akademie der Wissenschaften: http://www.deutschestextarchiv.de.

the Scaife Viewer from the Perseus Project.[14] These projects recognized that standard formats like TEI-XML, while valuable for capturing archival editions of texts, are not necessarily the only, or even the best, formats for analysis or publication. For example, scholars commonly want to quote a few sentences from a larger text, but if those sentences do not align perfectly with the structure of XML markup, the resulting quotation can cause errors by being invalid XML. Or a scholar might want to work with a small subset of a large database, without necessarily reproducing the complex relational database installation and set-up. Or, a linguistic analysis might want to count words or find patterns of words, but the editorial notes and comments embedded in a TEI-XML file would confuse such analysis. CITE provides workarounds for scholarly problems like these, while always keeping new analyses or readings aligned with the archival original.

With image-based editing, there are many formats and code-libraries available to scholars, all with their strengths. The IIIF protocol is broadly used by libraries and museums, often in conjunction with the OpenSeadragon library for making web-based, "zoomable" interfaces to high-resolution images. For offering interfaces to images without the complexities of an IIIF server, there is the DeepZoom image format.[15] Sometimes, of course, a scholar might want a simple JPG image. CITE works with all of these, allowing an image, or a part of an image, to be identified precisely so that the identification remains valid for a version of the image in an IIIF service, on a DeepZoom web-view, or on a static JPG, PNG, or TIFF file. The CITE Binary Image code library supports all of these formats.

Finally, while the universally adopted standards for scholarly data—XML, RDF, IIIF, SQL, etc.—provide structure and functionality, CITE complements these by allowing us to add validation and verification of a complex digital library. Validation (as used in CITE) is error-checking that a machine can do—"is every physical surface of the codex documented with an image?" "Is this a valid Nahuatl word?"—while verification is error checking that requires a human reader, but in which a computer can help: "Are all icons identified as the hero Xolotl actually showing that hero and not another?" Both kinds of checking require working across data-types, checking a text against a database of lexical words, or regions on images with a registry of mythological figures.

4. Distributed Editing

One of the developers of the CITE protocol, Neel Smith, has always asserted that "It is easier to aggregate than to disaggregate". This has been a guiding value for the project, and it can serve well for ongoing work on these manuscripts.

[14] Tufts University: https://scaife.perseus.org/.

[15] The International Image Interoperability Framework: https://iiif.io/.

For collaborative editing across three continents, where technological resources are necessarily limited, CITE's emphasis on plain-text, tabular data can prove helpful. Because canonical citation by URN-identifier is the only linking mechanism, even very large, very diverse digital libraries can consist of a (perhaps very long) list of, either (a) URN + Data, or (b) URN + URN.

Unlike, for example, an artifact documented using TEI-XML, whose well-formedness and validity, and any transformations to it, depend on the single document's integrity, a CITE library data is easily aggregated from different sources. A user with an inexpensive laptop running only a web-browser, with access to, *e.g.,* Google Docs, could generate commentary on an image, and by sharing a URL to that document, have their commentary integrated, with attribution, into a larger library.

Because, in the world of CITE, a commentary can be expressed simply as a collection of comments, each one associated with either a passage of text, or an object in a collection (which might be an image, or a region-of-interest on an image), the number of commentaries, and the number of commentators, can scale without limit, and there need not be any hierarchy of implied value.

It is important to distinguish between *traditional* citation and our use of *canonical* citation. Most of the texts relevant to this project have no traditional scheme of citation. To render them canonically citable, for the purposes of this work, we simply invent a citation-hierarchy that is organic to the structure of the text, independent of any particular presentation of the text (so, page numbers from one edition would not be appropriate), which (for prose texts at least) aligns across versions of the text (editions and translations) and which captures the semantics of the text. Like many texts (epic poem, biblical texts) a two-level hierarchy of Book + Section is usually sufficient.

To describe briefly how CITE would serve as the basis for an evolving body of commentary and exegesis of the *Codex Xolotl*, we can walk through some scenarios. First, a scholar might work to associate individual scenes on the Codex (clusters of figures, icons, and illustrations) with events described in Torquemada's *Monarquía Indiana*. By identifying regions-of-interest on images of the Codex, a reader can generate URN identifiers for specific graphical components (a depiction of the character Xolotl, that of an Aztec woman, that of a lake, dots representing the passage of time). The reader could identify these with individual URNs, or generate a URN to a region of interest that bounds the whole "scene", *or* identify individual scene and calculate the region of interest bounding box that includes all of them. This reader could associate these scenes with passages of text, identified by canonical URNs, in Torquemada's text, at any level of granularity, from a whole section down to a short phrase or single word. This association would simply look like a two-column text file, with URN-of-scene in one field, and URN-to-text in the associated field. The whole record would constitute a CITE "Collection" with its own URN, associated with the scholar who asserts these connections. A second reader with different ideas about how to interpret the Codex could generate a different table of associations, as a different work of scholarship. The associations of

image-to-text need not be exclusive, need not be coordinated, and need no elaborate infrastructure beyond a text editor, or something like a Google spreadsheet. The "texts" that can be canonically citable in CITE need not be ancient text, nor previously published texts. Any text, including oral histories or interviews with members of the Nahuatl communities are canonically citable in CITE. The activities of commentary and exegesis can proceed in many places at once, among different communities of interested readers, without granting privileged status to any of them. Any collection of observations carries with it authorship, and as data would be cited like any scholarly source, whether it comes from people living in a community of professional scholars at a European University. Integration would merely be a matter of bringing copies of text files together for some purpose. One of the foundational principles of CITE is that it is *always easier to aggregate than to disaggregate*, and we think this principle will be especially important for a text like the *Codex Xolotl*, of interest to so many parties, and continuing to pose so many fundamental questions. A primary virtue of CITE has been its simplicity of use in collaborative study of the Codex Xolotl. By itself, the novel ability to canonically define (CITE) and present a region or regions of interest in a graphic, rather than alphabetic, manuscript facilitated communication, analysis, and commentary on Codex Xolotl among the authors of this chapter and other collaborators. Stored collections of "URNs" and images captured through CITE have so far facilitated the construction and publication of one article on it (Offner 2021b), with more to follow.

The infrastructure for this small collaborative community, along with the intellectual property rights, were, it must be noted, already in place. Investigators in the U.S. are assumed to have capable computers with robust internet connections that they can readily adapt to use of shared programs. Offner owns but will be releasing under appropriate creative commons licenses in the coming years for his multispectral Codex Xolotl images, and the BnF, under French law, does not impede non-profit publication of images of items in their collection. Indeed, it has posted visible light images of its own in an IIIF viewer for public inspection.

In a parallel example, the digital map of Cuaxicala above demonstrates what its community members can do with sufficient resources. No attempts have yet been made to introduce people there to CITE, but there is no doubt they could quickly learn to adapt it to their needs. Both computers and internet connectivity are expensive in local terms. These could be made available to community members at an educational institution, ranging from the telesecundaria within Cuaxicala to the Universidad Intercultural del Estado de Puebla (UIEP). They can easily produce a set of photos of their prized Tlalamatl Cuaxicalan and arrange to store them on a server within Mexico, perhaps also at the UIEP. From that point, community leaders could arrange for study sessions moderated by young community members instructed in CITE and data entry and storage protocols. These could easily be annotated to identify the contributing

community member. The instructions and protocols could also be rendered in any of the several Indigenous languages in the region, although only Nahuatl and Spanish are now spoken in Cuaxicala. Abundant and strong motivations already exist: curiosity, civic pride, language and cultural revitalization, and the centuries-old use of their Tlalamatl Cuaxicalan as "defender of their lands."

Results could be distributed as the community sees fit. In recent years, such sharing of images of the manuscript has been open and scarcely moderated. On the one hand, the community is interested in making its by now famous manuscript better known, but on the other hand, with many images already made and distributed in regional social media and worldwide scholarly networks, it has neither funds nor ability to enforce intellectual property in any jurisdiction or to benefit commercially from images of its manuscript. In recognition of their intellectual property rights, goodwill, and expense in sharing information about themselves and their Tlalamatl, academic researchers, and especially their employers and granting agencies, should in future allocate funding for the community in any research project involving Cuaxicala and other communities similarly situated.[16] Documents are not simply "discovered" by academics with ensuing intellectual property rights and career benefits for them and their employers. Instead, such documents are, in the first instance, shared with academics by the documents' owners, and the benefits generated from this sharing should benefit all.[17] Offner and his wife Kathleen, who generate neither income nor career development from their research activities, donate to the community from time.

5. Conclusion

Because "Digital Humanities" is practiced by humanists, it is not surprising that the traditional disciplinary divisions tend to persist. European historians, doing digital work, tend to collaborate with other European historians doing digital work. Classicists with Classicists; scholars of Mesoamerica with other scholars of Mesoamerica. This is regrettable and perhaps unnecessary. One of the great advantages that computational work affords a humanist is the necessity of abstraction, of asking "what, in essence, are we looking at?" When the answer is "information-bearing surfaces, whose interpretation is in doubt," we should be able to share tools and approaches, and a distributed approach focus-

[16] There is good precedent for this approach. Cuaxicala astutely negotiated for and received substantial enhancements to electrical service and road construction and maintenance from the state of Puebla in exchange for their assent to have their manuscript published by Stresser-Péan in 1995.

[17] On IP and heritage sovereignty see also Granados García & Ashley (Chapter 9 in this volume); Okorie (Chapter 11).

ing on data, as opposed to applications or presentation, in the simplest formats might be most helpful.

Simple, readily deployable technologies such as CITE, provide opportunities to engage, and indeed, privilege, the insights and understandings of the descendants of the people who produced Mesoamerican graphic documents. The continuity of their languages and cultures across centuries is well demonstrated. There is considerable urgency to this task, as members of older generations pass away and Indigenous language use decreases. As Granados and Ashley describe elsewhere in this volume, "Digital tools offer a fluid and flexible set of resources to capture and represent … complex systems of individual and overlapping knowledge and are especially relevant in situations where knowledge is not catechised by western tropes of learning and linear process." That is, we have open questions that might admit of answers from different communities of learners, all of whose voices should be welcomed and preserved. Now is their time to be heard.

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