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Against infrastructure: global approaches to digital scholarly editing

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Introduction

Digital scholarly editions are one of the oldest forms of output of digital humanities (DH) research projects, and arguably one of the most prolific (Pierazzo 2019). Like all DH projects that result in the creation of digital output – typically a website – digital editions are not immune to what Smithies et al. call the 'digital entropy of software and digital infrastructure' (2019). While software and infrastructure are instrumental to the editorial work of a digital edition project during its entire lifecycle, this entropic process begins right after the *launch* of an edition's website. In other words, as soon as a digital edition becomes available to its intended audience, the risk of it disappearing from the web grows, as funding and interest in keeping infrastructure available dwindles. A critical research approach to the infrastructure that keeps digital editions online is fundamental to the future of digital editing and publishing, but it is often a secondary matter for projects focused on the editorial work, the scholarly significance and the logistics of making the edition a reality.

The kind of publishing infrastructure needed by scholarly editions can vary greatly; many are somewhat experimental in nature, partly pushed by the need for achieving technical innovation in order to

secure funding. Elena Pierazzo, adopting a fashion industry metaphor, calls these editions '*Haute Couture*' (Pierazzo 2019). They are characterised by experimentation and innovation, pushing at the boundaries of what scholarly editing can do as a research practice. At the opposite end of the spectrum, Pierazzo proposes a '*Prêt-à-Porter*' editorial model, whereby projects would rely on pre-existing tools and infrastructure to publish smaller-scale editions, or editions that for one reason or another do not warrant (or cannot afford) to be digitally experimental. *Prêt-à-Porter* editions are not entirely achievable, given the lack of tools and infrastructure capable of fully supporting them. Nonetheless, Pierazzo argues that such an approach would renew emphasis on the text being edited by abstracting away most technical issues and by avoiding a race for digital innovation. Additionally, the tools and infrastructure required would make digital editions a more desirable publication for scholarly editors and would 'consolidate the achievements of digital editing' (Pierazzo 2019). But who would be in charge of providing this kind of infrastructure? While funders have started requiring data management plans and maintenance plans, the problem of what happens to a funded digital edition after the conclusion of a project is inevitably outsourced to a different entity, such as a University IT department, a digital publishing house (few are willing to support digital scholarly editions) and commercial platforms,[1] or national infrastructures.[2]

Infrastructure is inevitably cast in a supporting role, while the project, or the edition, is the focal point of scholarly work. This has led many to characterise infrastructure for DH projects as something that should 'just work' and be as invisible as possible (del Rio Riande 2022) or even as something 'diabolical … that performs a type of secret and silent' work (Verhoeven 2016). The reality, as both these scholars

1 Such as Gale, which has been offering services for digital publishing in DH (https://www.gale.com/intl/primary-sources/digital-scholar-lab) or *Rotunda* at the University of Virginia Press (https://www.upress.virginia.edu/rotunda/) or the Illinois Open Publishing Network (https://iopn.library.illinois.edu/).

2 Like Huma-Num in France (https://documentation.huma-num.fr/humanum-es/), or all the national chapters of DARIAH in Europe or associated countries.

highlight, is that infrastructure is not only central to the existence of DH projects, but it can be at the heart of 'inventiveness and interpretive resourcefulness' (Verhoeven 2016). Nonetheless, projects and infrastructure remain separate concerns because of scope, goals, and the people involved likely belonging to separate teams. Digital scholarly editing – a creative process with a need for maintenance – must take into account from the start how infrastructure and those who maintain it will shape the project's scope, reach, and long-term existence on the web. Digital edition projects may want to consider how much infrastructure they really need, or if they need an infrastructure partnership at all. Rather than suggesting that infrastructure should 'just work' and be 'invisible', this provocation questions whether infrastructure is needed at all or, more realistically, how little infrastructure is in fact needed for digital editions. In other words, how much of a digital edition can be successfully published without the involvement of further parties dedicated specifically to its existence on the web?

On a more practical note, infrastructure for publishing scholarly edition websites has a cost that grows with the complexity of the system needed and this cost doesn't have to be exclusively financial; it may also include the ability to access institutional or public infrastructure and to what degree. In such a brittle environment, digital editions risk falling through the cracks. In describing how the King's Digital Lab (KDL) managed over a hundred legacy projects (including digital editions), Smithies et al. explain that not all projects should be maintained in perpetuity. Some are better conceived as short-term or even momentary interventions in the scholarly conversation, to be archived online for the historical record but not worth the intellectual, technical and financial overhead of ongoing maintenance (Smithies et al*,* 2019).

This statement is an important reminder that those in charge of infrastructure are also determining, particularly in the long term, the scholarly worth of a project, whether it should remain online, and in what form.

Infrastructure for scholarly editions today

The requirements for keeping a digital edition online after launch largely depend on the software used to build it. XML technologies are, and have been, particularly apt given the central role of the Text Encoding Initiative (TEI) XML format in the field. In order to support querying and transformation to HTML, TEI data is typically hosted in an XML database capable of supporting and publishing a web application online. TEI Publisher (https://teipublisher.com/) is the quintessential example for this kind of setup: built on the open-source XML database eXist, it offers a powerful and flexible web publishing environment for both developing and managing digital editions. The aforementioned KDL has, over the years, developed Kiln,[3] an in-house publishing solution for its numerous TEI projects. Many other digital editions opt to write their own custom code and web applications.[4] Once an edition is published, these various tools need infrastructure and maintenance to remain online. Often this burden falls among the responsibilities of technical partners of the digital editions, such as a DH lab or university library. KDL, for example, requires project partners to agree to a 'Service Level Agreement' to determine how long and in what form a project will be hosted on their infrastructure (Smithies et al. 2019).

National and nonprofit organisations may offer an alternative space for publication, particularly in the European Union (EU), where a number of initiatives have addressed EU requirements for Research Data Management (European Commission 2017). For example, Huma-Num, the French national infrastructure dedicated to Digital Humanities, hosts a number of digital editions.[5] The goals behind

3 Kiln documentation: https://kiln.readthedocs.io/en/latest/.

4 Many can be found in the comprehensive *Catalogue of Digital Editions* (https://dig-ed-cat.acdh.oeaw.ac.at/), which includes a brief 'infrastructure' field for each catalogued edition (Franzini, Terras and Mahony 2016).

5 For example, the *Electronic Edition of the works of Jean-Joseph Rabearivelo*: https://rabearivelo.huma-num.fr/exist/apps/jjr/index.html. Many of the editions hosted on Huma-Num result from a partnership with the nonprofit *e-editiones*

Huma-Num are to centralise research data to avoid dispersion and loss in the large volume of data created through research and to relieve the individual researcher, or even the research lab, from the responsibility of long-term preservation (Larrousse and Marchand 2019). TextGrid, in Germany, was one of the earliest Virtual Research Environments for the Humanities and still provides publication infrastructure for editions and their data.[6] Currently, it is part of the larger EU-backed research infrastructure projects CLARIN and DARIAH.[7] This level of support to public infrastructure applicable to digital editions is somewhat unique to the EU; access to its resources, however, is not guaranteed and the process for submission and acceptance is not entirely transparent.[8] Additionally, the goals of these centralised systems do not always go hand in hand with what the academic community needs (van Zundert 2012).

The situation is more encouraging for research data repositories, where individual researchers and institutions are able to submit and preserve for the long-term discrete research output. Digital editions, just like many research endeavours, create a number of research artefacts during their lifecycle, including articles, conference presentations, code, and TEI data. TEI's role as archival and interchange format is an advantage for the long-term preservation of digital editions that use it: TEI is designed to model[9] and encode both the text – for example, from an extant source – and the scholarly inter-

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spearheaded by the company eXist Solutions GmbH. Other projects like DiScholEd – Digital Scholarly Editions (https://discholed.hu-manum.fr/) are part of similar partnerships.

6 https://textgrid.de/ and https://textgridrep.org/.

7 DARIAH Teach offers tutorials in different languages about DSE: https://teach.dariah.eu/course/view.php?id=32.

8 For example, the TextGrid home page states, 'Would you like your own XML encoded files to be archived, made quotable and accessible through the TextGrid Repository? Then contact us: https://textgrid.de/en/kontakt/.'

9 To 'model' here is intended as the scholarly act of turning cultural objects of investigation into computable data, as theorised by, for example, McCarty (2005) and Flanders and Jannidis (2015).

vention of editors during transcription and editing. This makes a TEI document itself an important record of the editorial work, even without a rich user-friendly front end. Though, without a digital publication, the TEI is not quite the whole 'edition'. The complexities of TEI XML publishing have historically taken a central role in the creation of scholarly digital editions. Scholars have highlighted the interdependence between data and its processing (for example, TEI and XSLT), arguing that code needed to achieve digital publication is as scholarly as the editorial model itself (Pierazzo 2011; Boot 2009; Clement 2011; Drucker and Svensson 2016) – though there are also arguments to the contrary (Turska, Cummings and Rahtz 2016).

In many disciplines researchers are encouraged to deposit data in 'domain' repositories, especially those that are FAIR-aligned, whenever possible.[10] A 'domain' repository – or a repository that hosts data from a specific discipline – will usually host specific types of data and have expertise in curating and making them interoperable for that discipline. As a result, leading domain repositories help maintain data quality, provide a level of peer review and help data meet community standards to enable interoperability and reusability. This is not the case for DH or digital edition projects, in which the decision related to the archiving of data in a repository does not rely on best practices or principles,[11] but depends on workflows (such as GitHub and Zenodo)[12] or on the infrastructure chosen;

10 FAIR stands for Findable, Accessible, Interoperable, and Re-usable data. The FAIR Data Principles seek to promote maximum use of research data. In research libraries and repositories, the principles can be used as a framework for fostering and extending research data services. FORCE11 hosts a page on the FAIR Data Principles: https://force11.org/info/the-fair-data-principles/.

11 FORCE11 has been releasing Principles for scholarly objects (https://scholarly-commons.org/) or data citation (https://force11.org/info/joint-declaration-of-data-citation-principles-final/), but only the FAIR (and CARE) principles seem to have entered some basic discussions in the digital humanities community (Harrower 2020).

12 There are some Best Practices for workflows via GitHub and Zenodo that allow researchers to connect code, data and their versions in a data repository, but

for example, by adopting Huma-Num as infrastructure for publishing and Nakala[13] as a data repository.

While research data repositories are not a solution for keeping digital editions online, they are a valuable and successful infrastructure for the preservation of digital editions as data. There are several data repositories that are already well established or are gaining ground, such as the aforementioned Zenodo, a general-purpose data research repository hosted by CERN and funded by the EU OpenAIRE project, which has become a popular and robust solution for storing and publishing research data, with even the option for assigning persistent identifiers, such as DOIs, to resources.[14] Another example is Humanities Commons, a successful nonprofit model that works as a social network and a data repository for the humanities.[15] These repositories are successful in part because their usefulness is clear to their users, who continue to submit to them in order to share and preserve their research data. Additionally their mission and required technology are fairly monolithic: the underlying systems are shared and robust (for example, https://dspace.lyrasis.org/) and are built for the singularly defined purpose of long-term storage. Keeping digital editions online as *publications*, on the other hand, has a variety of needs besides storage to support elaborate front-end interfaces, search and other services.

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mainly for science, technology, engineering, and mathematics, such as these ones developed by a Geodynamics community: https://github.com/geodynamics/best_practices/blob/master/ZenodoBestPractices.md.

13 Nakala's site: https://nakala.fr/.

14 Persistent Identifier (PID) is a long-lasting reference to a digital object (document, web page and so on) that is globally unique, persistent, and resolvable. A digital object identifier (DOI) is a persistent identifier to uniquely identify documents and resources according to a standard and catalogue maintained by the International DOI Foundation.

15 This is achieved through Humanities Commons CORE: https://hcommons.org/core/.

In this infrastructural landscape, digital edition projects are left with few solutions for the preservation of their publications; unless their edition (or editors) can sway capital and influence to afford private infrastructure or navigate the red tape of institutional and national infrastructure, access to open research data repositories seems to be the best solution, albeit unsatisfactory in its incompleteness.

Another way of gaining perspective on the requirements for keeping digital editions online, is to look at how older projects have remained online. Projects with substantial institutional involvement are maintained and remain online, such as the Rossetti Archive, started in 1993 at the University of Virginia (http://www.rossettiarchive.org/); the Internet Shakespeare Archive, started in 1996 at the University of Victoria (https://internetshakespeare.uvic.ca/), or Van Gogh's Letters, published in 2009 by the Huygens Instituut (https://vangoghletters.org/). What happens to smaller-scale projects, or those with less visibility? A common solution has been the creation of static websites derived from the original more complex websites. KDL has taken this approach, with the goal of 'preserving functionally limited but usable "static" websites rather than complete systems' (Smithies et al. 2019). The Maryland Institute for Technology in the Humanities, with over 20 years of activity in DH, has taken the same approach to archiving legacy projects (Summers 2016), including digital editions (for example, John Milton's *A Maske* or *Comus*. Eds. Helen Hull, Meg Pearson and Erin Sadlack https://archive.mith.umd.edu/comus/). Static sites are the natural choice for these archiving activities because they only require the absolute minimum from hosting infrastructure: a server to distribute documents at a given address. The sites themselves, once created, require no active maintenance and can be easily moved and transferred like any other collection of files. However, static sites cannot support features that would require an active server, such as large-scale text search and user management; these features, therefore, are removed when projects are archived into static sites. Deriving static sites from an end-of-life project is the clear choice when access to infrastructure becomes limited. What would it take to adopt static sites from the start to avoid infrastructural constraints?

Minimal computing and the static site turn

The difficulty in accessing reliable infrastructure has been an issue for more than just editorial projects, but more generally for scholars who start approaching DH after having acquired, through formal and informal training, sufficient competence in the tools needed for their studies (Allés-Torrent and Riande 2020). Even more organised research groups may find themselves with limited access to their institution's infrastructure or encounter problems when using external services (del Rio Riande 2022). Minimal computing emerged in the United States as a reaction to the lack of access to institutional infrastructures, or their inadequacy to respond to the needs of DH projects and, in particular, those with a certain urgency in responding to current sociocultural events (Gil and Ortega 2016).

In an interview with Cuban architect Ernesto Oroza, Alex Gil (2016) introduced the concept of *architecture of necessity* and applied it to DH projects and the infrastructure that supports them. Oroza had coined the concept of *architecture of necessity* to describe the expansion of the city of Havana, Cuba, which occurred spontaneously and in response to the immediate needs of its inhabitants; sometimes in contrast to government regulations and attempts to re-organise and regulate its development. According to Gil, this is largely comparable to the development of DH research projects that have emerged and continue to emerge despite difficulties in obtaining funding and access to infrastructure. An important consequence of the lack of access to funding is the approach of humanities researchers to technical tools, such as basic web programming, 'without the help we cannot get' (Gil and Ortega 2016). Here again, Gil draws on a concept by architect Oroza that describes the *moral modulor* as an individual who builds and learns to build out of necessity by focusing on what is useful and necessary; a moral scale perspective that, reworking Le Corbusier's proposals, is also purely physical.[16]

16 The *modulor* is a system of mathematical measurements between humans and nature developed in the 1940s by the Swiss architect Le Corbusier, in collaboration with André Wogenscky.

The concept of 'necessity' is quite central to the minimal computing approach, as shown by a more formal definition of the approach in a recent retrospective:

> … minimal computing is perhaps best understood as a heuristic comprising four questions to determine what is, in fact, necessary and sufficient when developing a digital humanities project under constraint: 1) 'what do we need?'; 2) 'what do we have?; 3) 'what must we prioritise?'; and 4) 'what are we willing to give up?' (Risam and Gil 2022).

The invitation to only adopt what is necessary to reach a research goal makes minimal computing applicable in multiple contexts and may thus serve as a common denominator for a more open and equitable DH: an approach that has the potential of being both globally accessible and locally adaptable. This adaptability is arguably brought forth through a conscious rejection of infrastructure:

> We need not wait for the affordances of infrastructure. In fact, I would argue that scholars adopting an infrastructure prematurely, or receiving a large grant for a project, might keep themselves from acquiring an intimate knowledge of the digital technologies they seek to employ and, by extension, from the means of producing their own digital humanities knowledge (Gil 2016).

This is in line with wider movements to reject commercial and institutional infrastructure, such as re-evaluations of autonomous 'self-hosting' for higher education infrastructure (Angeli et al. 2022) and similar discussions around the *Computing within Limits* annual workshop (https://computingwithinlimits.org/).[17] Some examples beyond DH and academia include the DIY Book Scanner, a global

17 In Latin America many open science or activist groups have stood against commercial software in Secondary and Higher Education. Good examples are the projects Conectar-Igualdad in Argentina or Plan Ceibal in Uruguay, that foster the use of libre software in schools and the use of open educational resources. See Dussel (2020).

community with chapters worldwide that has 'taken preservation in their own hands'.[18] Or the movement for 'feminist servers' by the Tactical Tech NGO, which calls for a more autonomous infrastructure that is not controlled by the male-dominated tech industry that participates in unethical practices through data collection and surveillance for monetary gain (Tactical Tech 2017).[19]

Practical applications of minimal computing have relied on static sites as a way of affirming independence from institutional infrastructure. The static site generator Jekyll (https://jekyllrb.com/) has been particularly popular because the code hosting platform GitHub supports it as a free publishing solution. Alex Gil and others, for example, have worked on Jekyll-based alternatives to infrastructure-heavy DH solutions, such as Wax (https://github.com/minicomp/wax), a collection and exhibition builder meant to provide an alternative to Omeka (https://omeka.org/). The *Programming Historian*, furthermore, offers a successful example of minimal computing applied to digital publishing. It is a multilingual open-access, peer-reviewed scholarly journal of methodology for digital historians that moved from Wordpress (which requires a server-side installation and constant maintenance) to a Jekyll-based static site approach. Despite sociotechnical challenges related to its growth into a multilingual publication, this approach has allowed the journal to flourish and avoid common technological pitfalls, including being bound by data models imposed by off-the-shelf systems (Lincoln et al. 2022).

The impact of minimal computing on scholarly digital editions, on the other hand, has been somewhat limited. The release of Ed, a Jekyll theme for digital editions (https://github.com/minicomp/ed)

18 DIY Book Scanner site: https://www.diybookscanner.org/en/index.html.

19 This approach has had a number of practical applications in the Global South; most recently, a group in India has brought training and resources to rural parts of the country to empower women of the community to manage their own data and record storytelling activities. See https://thebastion.co.in/politics-and/tech/a-feminist-server-to-help-people-own-their-own-data/.

has resulted in a number of 'minimal editions', ranging from student-led editions (Mini Lazarillo, https://minilazarillo.github.io/) to more scholarly editions (*Margaret Cavendish: Philosophical and Physical Opinions*, https://cavendish-ppo.ku.edu/).[20] Ed intentionally avoids support for TEI, in favour of simpler, more minimal, text encoding solutions such as markdown or HTML. This decision has likely kept Ed to the fringes of scholarly editing, given the prominence of TEI in the field because of its ability to encode both text and editorial process. Nonetheless, the advantages of static sites and the need for more independence from infrastructure highlighted by the minimal computing movement, has not gone unnoticed in TEI circles. Even preceding minimal computing, TEI Boilerplate (https://dcl.ils.indiana.edu/teibp/) provided a preliminary solution for displaying TEI documents directly in the browser by relying on CSS and browser-supported XSLT. TEI Boilerplate intended to bring the richness of TEI semantics closer to the final user, avoiding transformations to the less expressive HTML format (Walsh and Simpson 2013). The consequence of focusing on browser-supported technologies demonstrated that static websites are a viable TEI publishing solution for many editorial projects. The JavaScript library CETEIcean improved on this model by eliminating the need for XSLT transformation in the browser (where native support for this technology is at risk) and by providing an extension mechanism for adding interactivity to TEI elements via custom code functions called 'behaviours' (Cayless and Viglianti 2018).

Examples of projects using CETEIcean include the Digital Latin Library (https://digitallatin.org/) and the new iteration of *Scholarly Editing: The Annual of the Association for Documentary Editing* (https://scholarlyediting.org/), which publishes small-scale digital editions with each issue. Inspired by minimal computing, the journal is open-access and uses static site technologies for longevity and

20 With regard to student-led editions and minimal computing as a pedagogical instrument, the authors of this chapter have also taught a transnational (USA and Argentina) course on digital publishing with minimal computing, involving both undergraduate and graduate students (Viglianti et al. 2022).

sustainability. In Latin America, the HD Lab, the digital humanities laboratory at the Argentinian CONICET (*Consejo Nacional de Investigaciones Científicas y Técnicas*) has been creating minimal editions via a workflow built around Recogito, an open source semantic annotation software developed by Pelagios Network (https://github.com/pelagios/recogito2), incorporating TEI markup and rendering the edited texts in static sites built with Jekyll and GitHub pages.[21] This minimal low-infrastructure approach was directly determined by the very limited funding and technological support granted to the lab. There are a few other digital edition projects relying on static sites, including the Jekyll and TEI-based Shelley-Godwin Archive (http://shelleygodwinarchive.org/) (Viglianti 2018), but this approach remains marginal, partly because of the deeply rooted history of TEI in Java-based XML technologies and the infrastructure they require.

Low-infrastructure futures of digital scholarly editions

The future of digital scholarly editions appears to be bound for web publishing with low-maintenance, low-infrastructure requirements. After a few decades of digital scholarly editing, it is clear that static site digital editions are more likely to remain online[22] and – as discussed above – those complex projects lucky enough to have technical partners willing to create archival exports end up as static sites as well, typically with reduced features compared to the original publications. The most high-profile digital edition projects, often based in the Global North, perhaps are and will continue to be the exception. This should be seen as both a challenge and an opportunity: focusing on low-infrastructure from the start may level the playing field for digital editions across the Global North and South,

21 HD Lab's site: https://hdlab.space/.

22 Such as *Frankenstein; or, the Modern Prometheus. The Pennsylvania Electronic Edition* from 1994 (Curran and Lynch 1994). See a representative page at http://knarf.english.upenn.edu/Colv1/f1101.html.

leading to more shared workflows, tools and resources. Project longevity, moreover, can go from a planned outcome to something achievable from the start. The minimal computing movement has put pressure on the inequalities of DH project work and the unequal access to infrastructure for keeping digital publications online. The responses to the principles of minimal computing – together with parallel experimentation with browser-supported technology – has begun to demonstrate that static websites are a viable option for digital scholarly editions from the get-go, or at least as a *planned* end-of-life option for projects requiring complex infrastructure during their lifetime, such as user management, crowdsourcing, machine learning and other semi-automatic aids to the editorial process. Perhaps, minimal computing and 'minimal editions' are more useful to digital scholarly editing as a provocation or set of guiding principles rather than as a methodology to which projects should subscribe wholesale. On many occasions, scientific concepts – and their statements – continue to be used despite the fact that their ability to describe and explain the world has diminished. Ulrich Beck considered that most concepts in sociology 'are misleading to some extent' (Beck 2004) and proposed the term 'zombie concepts' to describe categories that endure after their 'death'.

This is perhaps evident from the many low- or anti-infrastructure movements parallel to minimal computing, such as the above-mentioned *Computing within Limits*, Tactical Tech's feminist servers, DIY Book Scanner, and – with a stronger focus on longevity – the *Endings* project at the University of Victoria, British Columbia (https://endings.uvic.ca/). 'Ending Your Digital Humanities Project from the Start' is the telling title of one of their conference presentations (Takeda 2018); the project has highlighted the fragility of web applications and has proposed principles to facilitate long-term preservation. The *Endings Principles for Digital Longevity* (Endings Project 2022) include, among other strategies, the reduction of both software complexity and dependency on infrastructure. The principles, in fact, go beyond infrastructure and propose guiding principles for the entire lifecycle of a DH project. Though, for the purpose of this discussion, the most relevant principle proposed by the Endings

project is that the so-called products of a project should be a static site that relies on 'standards with support across all platforms, whose long-term viability is assured. [Their] choices are HTML5, JavaScript and CSS' (Endings Project 2022), which are web standards and the fundamental technologies of static websites.[23]

Targeting low-infrastructure requirements and static websites may not seem fitting for some editorial projects. It was not long ago when crowdsourcing seemed essential to the future and democratisation of scholarly editing (Ridge 2014; Blickhan et al. 2019); other chapters in this book may be pointing to future research directions involving algorithmic approaches such as machine learning for collation, or cognitive computing techniques for the transcription and annotation of textual sources. It should be safe to assume that, in scholarly editing, these tools are meant to be part of a workflow that culminates in a digital publication. Institutional infrastructure may be needed in order to support these more complex – particularly in the algorithmic sense of the word – activities related to transcription, content creation, and annotation; digital publication, however, is best supported by low-infrastructure approaches.

The minimal computing heuristic is useful to help projects face the technical limitations of static websites, particularly the question: 'what are we willing to give up?' During the lifecycle of the project, but particularly once the editorial process is completed, what features are strictly necessary? User management and rich text and faceted search are problematic in a static site without having to rely on third-party services that could incur a cost and would eventually become unavailable.[24] Search features, if not non-

23 The principles also suggest keeping away from external JavaScript libraries, something that is arguably not as urgent when JavaScript tools and frameworks are increasingly proficient in targeting JavaScript, known to be supported by the widest range of browsers. It is less clear, however, if JavaScript embedded in the page, as opposed to linked to external repositories, would be compliant to the *Endings* project principles.

24 See how the Shelley-Godwin Archive (http://shelleygodwinarchive.org/), a static

negotiable, are probably the hardest to forfeit, given their central role to textual discovery by user-readers of a digital edition. There are many search solutions that work in the browser,[25] including at least one emerging from the XML and TEI technical sphere (Takeda and Holmes 2022). The main issue remains scalability, since search indexes, which can be sizable for larger editions, need to be downloaded by the end user. This may need strategic planning around both document and indexing structures in order to only distribute the smallest possible amount of data useful at a time. This kind of consideration is another important reason for planning about static site delivery from the beginning of a project, as opposed to an afterthought.

Ultimately, infrastructure is about the people that make it possible. Smithies et al. argue that 'a failure of post-millennium digital humanities' is the lack of 'permanent DH development teams'. If they were in place, they could 'resolve most issues of sustainability and maintenance' (Smithies et al. 2019). Acknowledging the centrality of people and ethics in the conception of infrastructure is essential to direct attention to an aspect of DH scholarship that, as we have seen, can too easily be invisible or secondary. While this shift takes place and as the field of critical infrastructure studies takes root (Liu et al. 2018), it is essential to address the many gaps of DH infrastructure, particularly when considering the inequalities of global DH scholarship (Viglianti et al. 2022). The work needed is both one of repair, such as the efforts undergoing to migrate decaying editions into archivable static sites and data, and of direct intervention. Minimal computing and the longevity principles of the *Endings* project are examples of the technological and methodological strategies needed to work against the current state of DH infrastructure, particularly for projects that culminate in digital publication, such as digital scholarly editions.

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site with a server-side search system, ended up losing its search system to obsolescence and lack of funding to develop a client-side solution, at least at the time of writing.

25 Lunr, as an example among many, is a popular system: https://lunrjs.com/.

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