# Toward Critical infrastructure Studies                    Alan Liu

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*This is an adapted version of a paper I last presented in full at University of Connecticut, Storrs. 23 February 2017. While it starts from the point of view of the digital humanities in particular, its main mission is to frame the idea of "critical infrastructure studies" in general.*

(This version: April 21, 2018.)

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## Foundation

Let me set the foundation first. My topic today is "infrastructure." More accurately, since there is no infrastructure except as objectified perspectivally, my topic is infrastructure from the viewpoint of the digital humanities (and new media studies).
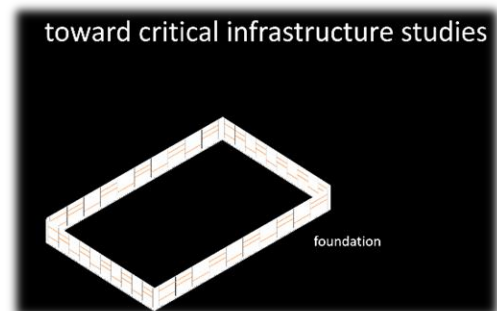


A prevalent contemporary understanding of the humanities and arts (with apologies to Matthew Arnold) is that their highest mission is to interpret the best *and* worst which has been thought and said in culture--with the critical end not just of knowing but of ethically evaluating and acting, at times to the point of social activism.

If that is the case, then the question has been asked--sometimes quite pointedly (as in the *Los Angeles Review of Books* last year[1])--how well, if at all, do the digital humanities contribute to the humanities mission as opposed simply to merging the humanities into neoliberal "knowledge work"?

The most constructive way to address this question, I think, is to realize that it's actually a muddle of two questions. The unintelligent or misinformed one is: can or should digital humanists be doing interpretation and critique in common with other humanists. The answer is simply "yes"--though a more detailed answer would need to drill down into how the very

notions of interpretation and critique are shifting today as their "scholarly primitives"

(protocols of evidence, pattern-finding, description, representation, comparison, etc.) are

shifting in the digital era. The more productive, sharply focused question is the following, which

I think it will repay digital humanists to take seriously:

What kind of critical interpretation is uniquely appropriate and purposive for the digital

humanities? That is, what kinds of interpretation and critique not only allow the digital

humanities to join up with leading modes of humanities research but could not be conducted

*except* through digital humanities methods that lead in their own métier--that being to use

technology self-reflexively as part of the very knowledge, and not just instrument, of

researching and acting ethically on society?

I suspect there will be several kinds of answers to this latter question--including the

potential of the digital humanities (in collaboration with new media studies) to address issues

of big data and algorithmic culture. But the answer I pose today is that the digital humanities

are uniquely placed to interpret and critique culture at the level of infrastructure--where

"infrastructure," the social-cum-technological milieu that at once enables the fulfillment of

human experience and enforces constraints on that experience, today has much of the same

scale, complexity, and general cultural impact as the idea of "culture" itself.

 Indeed, it may be that in late modernity the experience of infrastructure at institutional

scales (undergirded by national or regional infrastructures such as electricity grids and global-

scale infrastructures such as the Internet) *is* operationally the experience of "culture." Put

another way, the word "infrastructure" can now give us the same kind of general purchase on

social complexity that Stuart Hall, Raymond Williams, and others sought when they reached for

their all-purpose word, "culture." Consider the way dystopian films produced at the onset of

the digital information age such as *Blade Runner* (1982) and the Mad Max films (beginning in

1979) characterized whole cultures by foregrounding infrastructure--in the former: glistening,

noir cityscapes defined by transportation and media technology; in the latter: desert landscapes

defined by fuel and water supply systems.  Those films gave a taste of the way late-modern
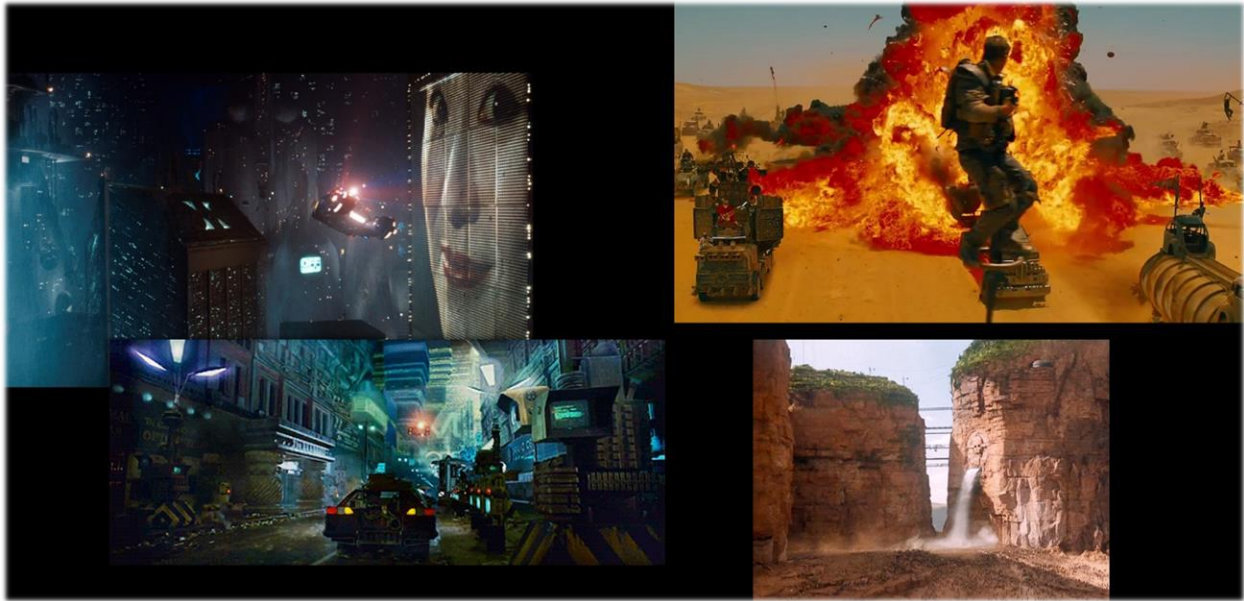


infrastructure--and, indeed, landscape and environment as interwoven with infrastructure--is

increasingly the mise-en-scène of culture. As Rosalind Williams wrote in her influential 1993

essay "Cultural Origins and Environmental Implications of Large Technological Systems":

infrastructure is "the outstanding feature of the modern cultural landscape." "What human

values and relationships are represented in the cultural landscape of the late twentieth

century," she asks, "especially in the dominance of pathways over settlements?"[2] Not just filmic

near-future or post-apocalyptic fantasy life, in other words, but *daily* life in our modern cultural

landscapes (driving, for example) steeps us in pervasive encounters with transportation, media,

and other infrastructures. These do not just neutrally convey the experience of culture but are

visibly parts of our cultural experience. Late modernity is thus car culture, cable TV culture, Internet culture, smartphone culture, and any other kind of "cool" culture where, as I studied in my *Laws of Cool*, "cool" is a cultural affect of both "smart" technologies and the knowledge workers who use them to be, or at least look, smart.[3] "Cool," as it were, is "transport" in another sense: an engineered Zen transporting us not *out* of daily life but deeper *into* its habituated routines secretly yearning for enlightenment.

The consequence of such convergence between infrastructure and culture for humanistic critique may be predicted as follows: especially in the digital humanities, critique must now begin to focus on infrastructure in order to have any hope of creating tomorrow's equivalents of the great cultural-critical statements of the past. Tomorrow's E. P. Thompson writing about the making of the working class, C. Wright Mills about white collars, Raymond Williams about culture and society, Michel Foucault about discipline, Judith Butler about gender and performativity, Donna Haraway about cyborgs, or Homi Bhaba about hybridity-- among many more who could be cited--will need to include in their works attention to infrastructure as that cyborg-being whose making, working, disciplining, performance, gendering, and hybridity are increasingly part of the core identity of late modern culture in ways no longer fully describable in older schemes of ideology-critique according to which infrastructure underlies an alternate, rather than thoroughly intermeshed, reality of superstructure. Superstructure has become compressed into infrastructure, and vice versa, where (to signpost my argument to come) the zone of compression is increasingly structured by the modern organizational institutions in which we are fully enmeshed.

## Support Beam 1 (Method)
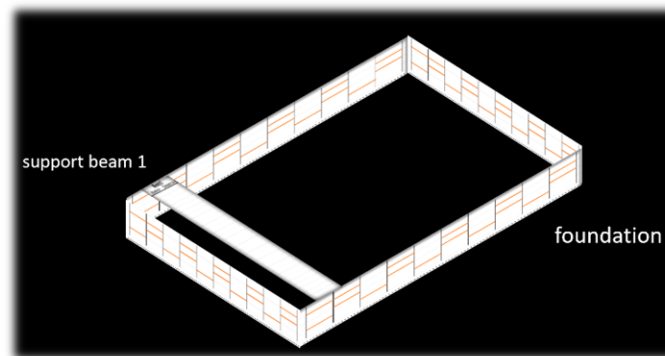


What would the method for a digital humanities cultural criticism focused on infrastructure look like? To give it a colorful name, I imagine that a method supporting such criticism must be "agile." I borrow this adjective from a contemporary approach to software development that, considered technically, is rapid, ad hoc, and incremental; and, considered socially, is iterative, adaptable, and collaborative (epitomized in so-called software development "scrums" with their rapid-burst sprints of collaborative work).[4] Not great systems of software formally modeled to near-Platonic specs by gigantic top-down consortiums, in other words, but scrums, and quilting parties, of rapid-release, results-oriented, and adaptive software issued informally by teams.

Less colorfully, the style of digital humanities infrastructural critique I imagine--one that takes advantage of modes of thinking already prevalent in the field--may be called lightly-antifoundationalist. The question that I concoct this admittedly prosaic phrase to answer is how much antifoundationalism--or, perhaps "anti-groundwork" (to allude to Marx's *Grundrisse der Kritik der Politischen Ökonomie* [*for a Critique of Political Economy*])--is actually useful for critical infrastructure studies. Mainstream humanistic critique has often been

antifoundationalist all the way down according to a three-stage logic that might be outlined as follows. (My argument here, I note, is roughly consonant with Rita Felski's recent critique of critique, which she conducts in part by reading the spatial [I would call them infrastructural] tropes according to which critics "dig down" into "gaps and fissures," "stand back" from it all, and so on.[5])

- In its first logical moment, critique recognizes that the "real," "true," or "lawful" groundwork (i.e., infrastructure) for anything, especially the things that matter most to people, such as the allocation of goods or the assignation of identity, is ungrounded. For example, while there are material reasons for resource allocation and the social relations of force needed to do the dirty deed--i.e., for political economy and society-- any particular political economy and society are arbitrary and, in the last analysis, unjust. Political economy and society are thus not grounds but, to play on the word, precisely ground*works*: particular ways of working the ground (i.e., a mode of production) supported by discursive, epistemic, psychic, and cultural institutions for ensuring that the work continues in the absence of rational or moral foundation.

- In its second logical moment, critique then goes antifoundationalist to the second degree by criticizing its own standing in the political-economic system--a recursion effect attested in now familiar, post-May-1968 worries that critics themselves are complicit in elitism, "embourgeoisment," "recuperation," "containment," and majoritarian identity, not to mention tenure.

- Finally, in its third logical moment, critique seeks to turn its complicity to advantage--for example, by positioning critics as what Foucault called embedded or "specific

intellectuals" acting on a particular institutional scene to steer social forces. A related idea is to go "tactical" in the manner theorized by Michel de Certeau, who argued that people immured in any system can appropriate that system's infrastructure through bottom-up agency for deviant purposes (as in his paradigm of jaywalking in the city).[6] Media critics, including new media critics, have adapted de Certeau's notion in the name of "tactical media," meaning media whose platforms, channels, and interface (the whole of what Lisa Parks and Nicole Starosielski call "media infrastructures") can be appropriated by users for alternative ends.[7]

From this total, three-part, antithetical logic of critique, we can observe, the digital humanities often tend to slice out just the latter tactical moment. Such slicing--hacking critique to severe its roots from purist antifoundationalism--brings the digital humanities into the orbit of several late- or post-critical approaches with a similar style (style rather than full-blown theory precisely because they eschew foundational purity). One approach that James Smithies has associated with the digital humanities is "postfoundationalism." Borrowing from the philosopher of science Dimitri Ginev, Smithies argues that postfoundationalism is "an intellectual position that balances a distrust of grand narrative with an acceptance that methods honed over centuries and supported by independently verified evidence can lead, if not to Truth itself, then closer to it than we were before."[8] Postfoundationalism is thus well matched to the digital humanities, Smithies suggests, if we think of the digital humanities as "a process of continuous methodological and . . . theoretical refinement that produces research outputs as snapshots of an ongoing activity rather than the culmination of 'completed' research."[9] A related idea is "critical technical practice," which Michael Dieter--building on

Philip Agre's writings on artificial intelligence research--makes a goal of the digital humanities. Dieter quotes from Agre: "The word 'critical' here does not call for pessimism and destruction but rather for an expanded understanding of the conditions and goals of technical work. . . . Instead of seeking foundations it would embrace the impossibility of foundations, guiding itself by a continually unfolding awareness of its own workings as a historically specific practice."[10]

Other ideas that are lightly-foundationalist in this way, though not to my knowledge yet applied to the digital humanities, include David Berry's notion of "tactical infrastructures," Bruno Latour's idea of "compositionism" (fixed on neither absolute foundations of knowledge nor absolutist refutations of such foundations but instead on mixed, impure, make-do, and can-do compositions of multiple positions), and Ackbar Abbas's "poor theory" (which uses "tools at hand" and "limited resources" to engage "with heterogeneous probings, fragmentary thinking, and open-endedness" in resistance to "totalization, restriction, and closure").[11] Also important is the recent emergence of feminist digital-humanities approaches to infrastructure, as in the panel at DH2016 on "Creating Feminist Infrastructure in the Digital Humanities," which featured Susan Brown, Tanya Clement, Laura Mandell, Deb Verhoeven, and Jacque Wernimont. Applying feminist principles in a way that is consonant with what I have termed "lightly-antifoundationalist," the participants ask in their panel abstract: "How can digital infrastructure, as technologies of connection, support complex, non-binary understanding?"[12] Or, as Verhoeven puts it in her essay of the same year titled "As Luck Would Have It: Serendipity and Solace in Digital Research Infrastructure": "A feminist digital archive would replace a technical ontology built on balanced, binary narratives with a set of principles that allow for the discernment of conflicting, asymmetrical, and incomplete vantage points."[13]

All these lightly-antifoundationalist approaches reviewed here, it may be noted, are

tactical rather than strategically pure because their very potential for critique arises from dirty-

hands proximity to, and sometimes even partnership with, their objects of critique. As in the

case of the Devil's bridges that Verhoeven makes her fable, such approaches have to at least

get near the devil's work to see its infrastructure.  Unlike distantiated critique in what Felski



calls its "stand back" mode, that is, tactical critique (as the root of the word "tactic" might

indicate) makes contact. Smithies thus notes postfoundationalism's function as a "bridging

concept" (a latent metaphor nicely homologous with Verhoeven's fable) for what he calls the

"interdependence" and "entanglement" of the digital humanities with postindustrialism.[14]

Indeed, I add that all the approaches thus far mentioned as a "light foundation" for critical

infrastructure studies are similarly contaminated by the double principle of efficiency and

flexibility, which (as I articulated in my *Laws of Cool*) is the two-stroke engine of the

postindustrial mode of production. As it were, all the approaches I have mentioned are

instances of "lean" and "just-in-time" critique and thus not dissimilar in spirit to the in-house

critique that postindustrial corporations at the end of the twentieth century began to design

into their own production lines by famously empowering workers to "stop the line" ad hoc or,

less catastrophically, to suggest incremental improvements (a kind of postindustrial version of

the "serendipitous" approach to infrastructure Verhoeven scrutinizes in her essay). Such dirty contact with postindustrialism is both the weakness and strength of lightly-antifoundationalist approaches, where weakness means being swallowed up by the system and strength comes from getting close enough to the system to know its critical points of inflection, difference, and change. If, as Smithies says, the digital humanities are "deeply entangled" in postindustrialism, in other words, entanglement need not be the same as equivalence. It is also non-binaristic engagement.

The critical potential of light-antifoundationalism in the digital humanities (criticism-"lite," as it were) can now be stated: it is precisely the ability to treat infrastructure not as a foundation or anti-foundation but instead as a nuanced, non-binaristic tactical medium that opens the possibility of "critical infrastructure studies" (as I and others have begun calling it).[15] It is such critical infrastructure studies operating as a mode of cultural studies that will allow the digital humanities to fulfill one of their most needed critical functions at the present time, which I believe is to help adjudicate how academic infrastructure connects higher education to, but also differentiates it from, the workings of other institutions in advanced technological societies. The critical function of the digital humanities going forward, in other words, is to assist in shaping smart, ethical academic infrastructures that not only further normative academic work (research, pedagogy, advising, administration, etc.) but also intelligently transfers some, but not all, values and practices in both directions between higher education and today's other powerful institutions--business, law, medicine, government, the media, the creative industries, NGOs, and so on.

## Support Beam 2 (One More Plank of Method)
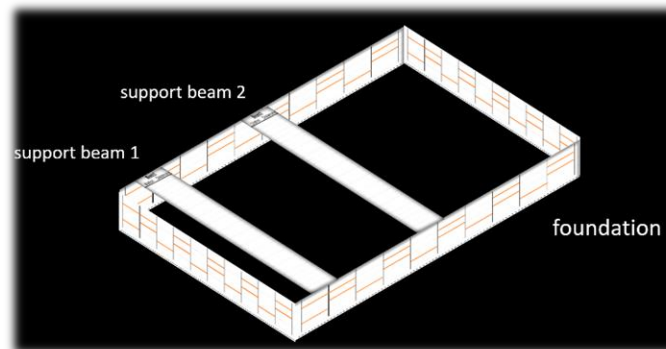


At present, some of the most influential general understandings of infrastructure (as cited, for example, by such digital humanists as Sheila Anderson and James Smithies, who study humanities research "cyberinfrastructure" in particular[16]) include: the Large Technical Systems (LTS) approach, descended originally from the historian Thomas Hughes's *Networks of Power* (1983), and the information-ethnography approach stemming from Susan Leigh Star, Geoffrey Bowker, and their circle.[17] Good expositions of both are combined in one of the best conceptualizations of infrastructure I have so far found: a document of 2007 titled "Understanding Infrastructure: Dynamics, Tensions, and Design" (whose authors include Bowker) representing the final report to the National Science Foundation of a workshop it sponsored.[18]

Supplementing these general approaches to infrastructure, I propose three other portfolios of thought that to my knowledge are largely unknown in the digital humanities and, for that matter, in the humanities as a whole even though they are broadly compatible with humanities cultural criticism.  Because powerful institutions--business, law, medicine, government, the media, and so on--are today the actors that most forcefully "innovate"

systems designed to enmesh cultural experience to infrastructure, we need a good way to

study those institutions and their infrastructure. The portfolios of study I suggest consist of:

- the "neoinstitutionalist" approach to organizations (which I take from the social

  sciences);

- the "social constructionist" (especially "adaptive structuration") approach to

  organizational technologies (which I take from the social sciences and

  information science) (highly consonant with neoinstitutionalism);

- and the emergent critical "maintenance, repair, and care" (versus "innovation")

  movement (which I take from science technology studies [STS]).

Taken together, these approaches allow us to explore how organizations are structured as

social institutions by so-called "carriers" of beliefs and practices (i.e., culture), among which

information-technology infrastructure is increasingly crucial. Importantly, all these approaches

are social-science or STS versions of what I have called lightly-antifoundationalist. Scholars in

these areas "see through" the supposed rationality of organizations and their supporting

infrastructures to the fact that they are indeed social institutions with all the irrationality that

implies. But they are less interested in exposing the ungrounded nature of organizational

institutions and infrastructures (as if it were possible to avoid or get outside them) than in

illuminating, and pragmatically guiding, the agencies and factors involved in their making,

remaking, and maintenance. Such approaches are thus inherently a good match for the

epistemology of building, unbuilding, and rebuilding in the digital humanities.

More than a good match, neoinstitutionalism, the social science of organizational

technologies, and the STS approach to the theory, practice, and ethos of "caring" for and

"repairing" existing structures offer exactly the right tactical opening for a digital humanities cultural criticism because they are all about the site on which the already existing critical force of the digital humanities is pent up: in-place institutional forms of technologically-assisted knowledge work. After all, the digital humanities stand in contrast to new media studies and network critique among cousin fields as the branch of digitally-focused humanities work that has been primarily focused on changing research, curation, authorship, dissemination, and teaching inside academic institutions and related cultural or heritage institutions rather than on broader commentary directed externally at society and social justice. The digital humanities are all about creating research collections and corpora; developing analytical, publishing, curatorial, and hybrid-pedagogical tools; establishing new university programs and centers; changing the accepted notion of academic careers (e.g., to include "alt-ac" alternative academic careers); and, ultimately, instilling a new scholarly digital ethos in the academy in the name of "collaboration" and "open access." As a consequence, the existing critical energy of the digital humanities--sometimes quite passionate and even militant--has been primarily devoted to such institutional issues. Breaking down the paywalls of closed publication infrastructures, for instance, is the digital humanities version of storming a university administration building in the 1970s.

I won't be able to complete the argument here, but it will be useful at least to put in place an initial introduction to the first of the portfolios I mentioned, neoinstitutionalism, which is the method that helps us frame the question: how do today's so-called "knowledge-work" institutions--corporations, for example, but also universities--"know," and how do information-

technology infrastructures shape such knowing (in other words, an updated version of the question Mary Douglas raised in the mid 1980s in her book *How Institutions Think*).[19]

Neoinstitutionalism addresses such questions. This is the influential approach to organizational institutions that arose among sociologists and organization theorists beginning in the early 1980s. Detailed explications of the method and narratives of its development are available in the canonical volume of essays edited by Walter W. Powell and Paul J. DiMaggio that is sometimes called the movement's "orange bible" (after the color of its cover): *The New Institutionalism in Organizational Analysis* (1991).[20]  Such explications are also available in more recent syntheses or collections such as W. Richard Scott's *Institutions and Organizations* (2008) and *The Sage Handbook of Organizational Institutionalism* edited by Royston Greenwood et al. (2008) (especially in the introduction to that work).[21] I offer here only an outsider's outline of neoinstitutionalism intended to make it accessible to humanists.
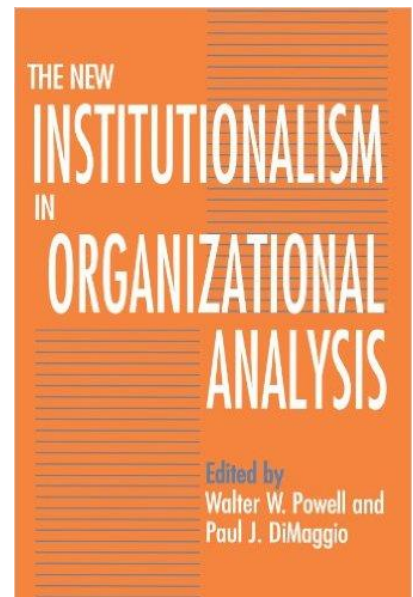
In my redaction, the neoinstitutional view of the nature and behavior of organizational institutions may be put in the form of the following sequence of propositions (which I redact even further here for this talk):

- 1. Organizations have an institutional dimension that is not the same as their organizational structures and processes.

- 2. The institutional dimension of organizations is non-rational and relational even when, or especially when, organizations appear to be rational in maximizing resources to reach

defined goals. In short, neoinstitutionalism's answer to the question, "how do institutions think?" is: "they don't think; they act like they think."

- 3. Intra-organizationally, institutions are motivated by different combinations of agency enacted by different personnel. In particular, neoinstitutionalists speak of "three pillars" of institutional motivation--"regulative," "normative," and "cultural-cognitive"--that together, but in different ways impel people to conform to, think in terms of, or "take for granted" institutional conventions. (Roughly translated: "regulative" means what someone tells you to do; "normative" means what everyone does; and "cultural-cognitive" means what you have internalized for what it is unimaginable not to do.)

- 4. Extra-organizationally, institutions are motivated by the collective behaviors and taken-for-granted thinking of their organizational "field" and "environment."

- 5. Both intra- and extra-organizationally, institutionalization tends to be a convergent process.

- 6. But organizations and organizational fields contain dissonances that can also make institutionalization a divergent process.

## Support Beam 3 (Primer on Neoinstitutionalisms)

*[This part of the paper is not included here. It discusses the "social constructionist" and "adaptive social structuration" approaches to organizational technology, and also the "repair" approach in science technology studies.[22]]*
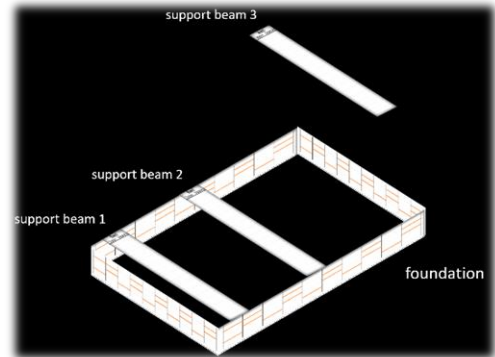


## Topping the Structure
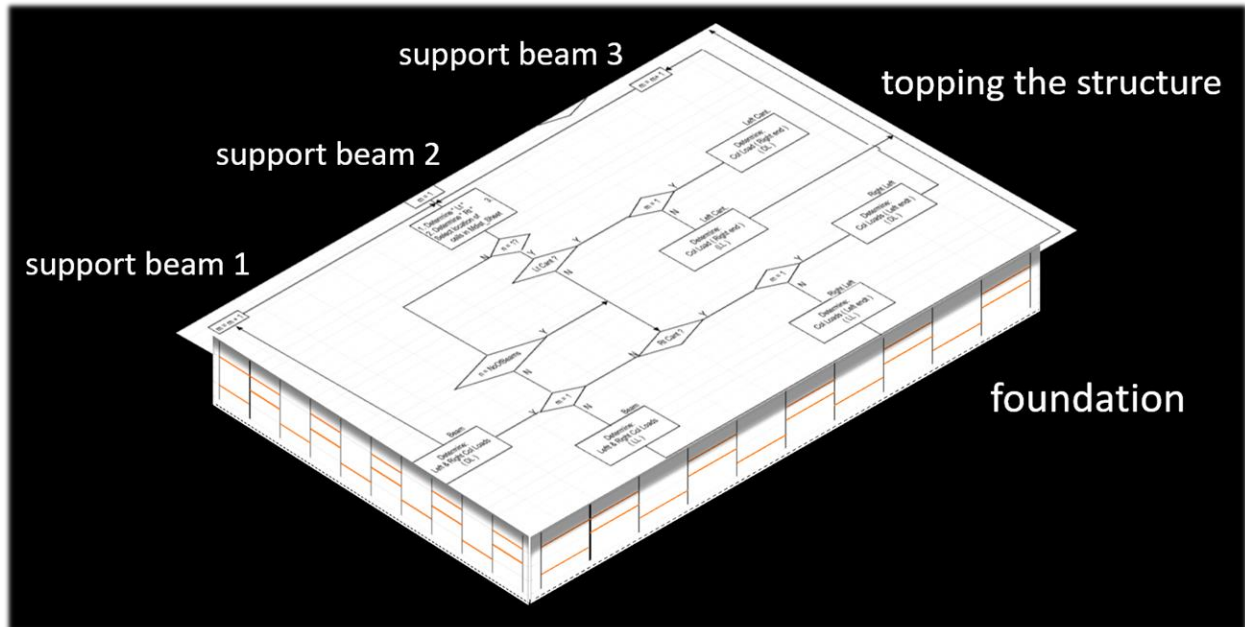


We haven't completed the building today, of course. What we have at best is a plan of research--one of many possible ones that bring the digital humanities in the university into contact with knowledge work in other institutions in a common endeavor of creating, using, evolving, and also thinking critically *about* infrastructure.

It is enough of a plan, perhaps, to provide the platform for me to close by asking this series of critical questions: Can neoinstitutional and social-structuration-of-technology

approaches to understanding the evolving relation between the academic institution and

today's more domineering institutions (most notably, business and government) help the digital

humanities release its intramural critical energy? Can that release help propel not just change in

higher education but, through higher education and the technological infrastructures that

mediate its relationship to other institutions, also extramural change in the larger society that

higher ed contributes to? In short, can the considerable existing intelligence, idealism, and

moral force of the digital humanities be redirected from being only an instrument of institution

work to becoming through interventions in instrumental infrastructure also a way to act on

institutions and their wider social impact?

But I do not wish to overreach, which is also why I think an approach focused on institutions

and their infrastructures is particularly appropriate. Ultimately, the digital humanities field must

be critical in a way that does not ask it inauthentically to reach beyond its expertise and

mandate to bear exaggerated responsibility for larger social phenomena. Acting out through

the digital humanities about larger social issues is necessary. But such actions must be

complemented by creating infrastructures and practices that make their social impact by being

what Susan Leigh Star called "boundary objects"[23]--in this case boundary objects situated

between the academic institution and other major social institutions. It is in this boundary

zone--just as one example, "content management system" infrastructures whose use by

scholars oscillates between corporate "managed" and "open community" philosophies--that

higher education can most pertinently influence, and be influenced by, other institutions

through what I earlier called "shared but contested information-technology infrastructure." It is

in this boundary zone of hybrid scholarly, pedagogical, and administrative institutional

infrastructure that we need the attention of skilled and thoughtful digital humanists, even if the interventions they make are not called anything as ambitious as "activism" but instead simply "building."

## Notes

[1] Daniel Allington, Sarah Brouillette, and David Golumbia, "Neoliberal Tools (and Archives): A Political History of Digital Humanities," *Los Angeles Review of Books*, May 1, 2016. Accessed June 10, 2017. https://lareviewofbooks.org/article/neoliberal-tools-archives-political-history-digital-humanities/.

[2] Rosalind Williams, "Cultural Origins and Environmental Implications of Large Technological Systems," *Science in Context* 6.2 (1993): 381. doi: 10.1017/S0269889700001459. Also available at: http://rosalindwilliams.com/wp-content/themes/twentyten-child/resources/culturalorigins.pdf.

[3] Alan Liu, *The Laws of Cool: Knowledge Work and the Culture of Information* (Chicago: University of Chicago Press, 2004).

[4] Wikipedia. "Scrum (software development)." April 21, 2018, at 18:59. Accessed April 21, 2018. https://en.wikipedia.org/wiki/Scrum_(software_development). Permanent URL for time-stamped version cited here: https://en.wikipedia.org/w/index.php?title=Scrum_(software_development)&oldid=837582217.

[5] Rita Felski, *The Limits of Critique* (Chicago: University of Chicago Press, 2015).

[6] Michel de Certeau, *The Practice of Everyday Life*, trans. Steven Rendall (Berkeley: University of California Press, 1984).

[7] On tactical media, see for example, David Garcia and Geert Lovink, "The ABC of Tactical Media,"

Nettime-l, May 16, 1997; accessed July 31, 2010, http://www.nettime.org/Lists-Archives/nettime-l-

9705/msg00096.html; Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture*

(Cambridge, Mass.: MIT Press, 2005); and Rita Raley, *Tactical Media* (Minneapolis: University of

Minnesota Press, 2009). On media infrastructures, see Lisa Parks and Nicole Starosielski, ed., *Signal*

*Traffic: Critical Studies of Media Infrastructures* (Champaign, IL: University of Illinois Press, 2015).

[8] James Smithies, "Digital Humanities, Postfoundationalism, Postindustrial Culture," *Digital Humanities*

*Quarterly* 8.1 (2014), accessed June 10, 2017,

http://www.digitalhumanities.org/dhq/vol/8/1/000172/000172.html, paragraph 27.

[9] Ibid., paragraph 29.

[10] Quoted in Michael Dieter, "The Virtues of Critical Technical Practice," *differences* 25.1 (2014): 216-

230, doi: 10.1215/10407391-2420051, p. 217.

[11] See David M. Berry, "Tactical Infrastructures," Stunlaw (blog), September 15, 2016, accessed April 21,

2018, http://stunlaw.blogspot.com/2016/09/tactical-infrastructures_94.html; Bruno Latour, "An

Attempt at a Compositionist Manifesto," *New Literary History* 41.3 (2010): 471-490; and Ackbar Abbas,

"Poor Theory and New Chinese Cinema: Jia Zhangke's 'Still Life,'" paper presented at Critical Theory

Institute, University of California, Irvine, December 2, 2008, accessed April 21, 2018,

https://www.humanities.uci.edu/critical/pdf/AbbasPoorTheoryStillLife.pdf. See also Abbas, "Poor

Theory: An Open Source Manifesto," Designing China Seminar in Experimental Critical Theory, 2009

(formulated in collaboration with David Theo Goldberg), on file with author. (A somewhat revised

version of the Manifesto was adopted as a project by UC Irvine's Critical Theory Institute. The CTI

version is archived at:

https://web.archive.org/web/20150922072125/http://www.humanities.uci.edu:80/critical/poortheory.pdf.)

[12] Susan Brown, Tanya Clement, Laura Mandell, Deb Verhoeven, and Jacqueline Wernimont, "Creating Feminist Infrastructure in the Digital Humanities," abstract for panel at DH 2016 conference, Kraków, in *Digital Humanities 2016: Conference Abstracts. Jagiellonian University & Pedagogical University, Kraków: 47-50*, accessed April 21, 2018 in HTML version, http://dh2016.adho.org/static/data-copy/531.html,

[13] Deb Verhoeven, "As Luck Would Have It: Serendipity and Solace in Digital Research Infrastructure," Feminist Media Histories, 2.1 (2016): 20. doi: 10.1525/fmh.2016.2.1.7. Also available open access at https://deb-verhoeven.s3.amazonaws.com/papers/AsLuckWouldHaveIt.pdf.

[14] Smithies, "Digital Humanities, Postfoundationalism, Postindustrial Culture," paragraphs 8, 3, 2.

[15] See the *Critical Infrastructure Studies* web site that I have started, which includes events and an evolving bibliography (http://cistudies.org).

[16] See Sheila Anderson, "What Are Research Infrastructures?," *Journal of Humanities and Arts Computing* 7.1-2 (2013): 4-23, doi: 10.3366/ijhac.2013.0078; and James Smithies, *The Digital Humanities and the Digital Modern* (Basingstoke: Palgrave McMillan, 2017), esp. chapter 5, "Towards a Systems Analysis of the Humanities."

[17] For the LTS approach, see Thomas P. Hughes's canonical *Networks of Power: Electrification in Western Society, 1880-1930* (Baltimore: Johns Hopkins University, 1983); available online at: https://monoskop.org/images/2/29/Hughes_Thomas_P_Networks_of_Power_Electrification_in_Western_Society_1880-1930.pdf. For the information ethnography approach, see Susan Leigh Star, "The

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