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From Optical Fiber To Conceptual Cyberinfrastructure

Patrik Svensson <patrik_dot_svensson_at_humlab_dot_umu_dot_se>, HUMlab, Umeå University

Abstract

There is currently an infrastructure turn with very real implications for the humanities and digital humanities. It comes not only with presumed technology or infrastructure, but also with certain assumptions, discursive patterns, and models. This paper analyzes these critically and advocates a humanities-based notion of cyberinfrastructure, not necessarily built on a science-and-engineering paradigm or exclusively grounded in existing humanities infrastructure. It is argued that we need to maintain a critical stance while simultaneously engaging in the exploration of research issues and technologies. There is often a gap between the material details of infrastructure and underlying, foundational ideas, and it is suggested that a model based on conceptual cyberinfrastructure and design parameters can be one way of connecting the ideational level with actual implementation. HUMlab at Umeå University serves as a case study.

Introduction

Whether or not *digital humanities* is a field can be disputed, but there can be no doubt that there is currently a great deal of activity, engagement, investment and expressed hope in the intersection of the humanities and the digital. This is the third article in a four-part series attempting to explore this very intersection, and it examines infrastructure for the humanities in relation to the current discourse of research infrastructure (or cyberinfrastructure) and the digital humanities. 1

In this article, I argue that the humanities need to consider the multiple opportunities associated with cyberinfrastructure, while maintaining epistemic integrity and avoiding modeling new infrastructure uncritically after existing models. For example, what is humanities cyberinfrastructure? How can we critically engage with the discourse and ideas of cyberinfrastructure? What are the infrastructural needs of the humanities? How can new infrastructure and digital humanities spaces be designed and implemented? The humanities are arguably in a position to co-create and co-construct their own notion of cyberinfrastructure, as well as implementing it, even if the discourse and its associated implementations do not necessarily conform fully to a science and engineering based model or previous layers of scholarly infrastructure. HUMlab, a digital humanities center at Umeå University, serves as a case study leading to a more general discussion of design principles and conceptual cyberinfrastructure for the humanities. Further, tentative advice as to implementing and strategizing humanities cyberinfrastructure is offered. 2

The article series, as a whole, traces digital humanities as a project in terms of history, epistemic commitments, modes of engagement with the digital, conceptual foundations for associated cyberinfrastructure, visions and hope invested, and future directions for the field, and necessarily, for the humanities at large. 3

In the first article, I examined the discursive transition from humanities computing to digital humanities, exploring how this naming is related to shifts in institutional, disciplinary, and social organization. I also addressed the epistemic culture and commitments of humanities computing, and tensions between this tradition and a broad notion of digital humanities. 4

In the second article, I explored the broader landscape of the digital humanities through a discussion of digital humanities and digital humanists, associated traditions, personal encounters and importantly, through a suggested set of paradigmatic modes of engagement between the humanities and information technology: information technology as a tool, an object of study, an exploratory laboratory, an expressive medium, and as an activist venue. 5

In the fourth article, I explore the multiple ways in which the digital humanities have been envisioned and how the digital humanities can often become a laboratory and vehicle for thinking about the state and future of the humanities at large. Some 6 foundational issues, including the role of the humanities and changing knowledge production systems, are discussed and related to the development of the digital humanities. Furthermore, a tentative vision of the digital humanities is presented. This vision is grounded in the article series as a whole as well as in the important collaborative possibilities and challenges that lie ahead of us.

Outline

The current article is divided into three parts. The first part discusses the notion and discourse of research infrastructure critically, and relates this to the humanities and humanities infrastructure. There is a significant gap between the grand visions of the discourse of cyberinfrastructure and the actual, implemented infrastructure. It is argued that it is essential that the humanities embrace current opportunities and explore multiple visions when considering cyberinfrastructure for the humanities, while avoiding the dangers of being uncritically modeled after existing humanities infrastructures or after technology and science based models. The second part investigates a particular example of digital humanities infrastructure in considerable detail. An attempt at bridging the gap mentioned above is made through introducing a three-layered model which incorporates conceptual cyberinfrastructure (underlying ideas and epistemic grounding), design principles (intermediate level articulation of conceptual cyberinfrastructure) and actual cyberinfrastructure (implemented infrastructure). Special emphasis is given to space, infrastructure and how ideational grounding and physical (as well as digital) implementation are negotiated. Finally, the third part of this article reflects on packaging, strategizing and implementing cyberinfrastructure for the humanities. This discussion draws on the previous parts, as well as experience from building a lab and engaging with the digital humanities community. 7

It is argued that this expansive approach can help provide a comprehensive picture of research infrastructure from visionary discourse to actual implementation, and support a sophisticated argument for humanities cyberinfrastructure. However, any analysis of such a complex matter as research infrastructure is necessarily partial, and while much of the study is fairly general, the case study has provided an important point of canalization. This also means that the idea of a physical, digitally inflected laboratory has influenced the work, and that some other aspects, including standardization and digital libraries, are given limited attention. 8

Part I: Cyberinfrastructure for the Humanities

Introduction

Research infrastructure, while traditionally not associated with the humanities, has become a topic of conversation on faculty boards and among researchers in the humanities. Moreover, there is substantial interest from funding agencies, councils and various organizations under rubrics such as cyberinfrastructure and e-science. At this point in time, there is a grapple for securing funding, defining key questions and aligning the humanities with an epistemic framework bearing a strong science and engineering legacy. There is no doubt there are many opportunities, particularly for a field such as the digital humanities, but also real risks and important considerations. What requires attention is not least the assumed epistemic and ontological neutrality of the ‘infrastructure move’ and, correspondingly, its assumed broad applicability for everything from geology to cultural studies. In this section, we will consider risks associated with modeling humanities cyberinfrastructure on existing infrastructure, or on a technology and science driven paradigm. The stakes are high, and the cyberinfrastructure movement as a whole – and its articulation as an important strategy in the humanities – can be seen as an epistemic power play. It is a power play with very real implications for the humanities and the digital humanities. 9

Research Infrastructure

In the *European Roadmap for Research Infrastructures Report 2006*, research infrastructures are defined as follows: 10

> In the roadmap, we deal with facilities, resources or services of a unique nature that have been identified by pan-European research communities to conduct top-level activities in all fields. This definition of Research Infrastructures, including the associated human resources, covers major equipment or sets of instruments, as well as knowledge-containing resources such as collections, archives and databases. Research Infrastructures may be *single-sited, distributed,* or *virtual* (the service being provided electronically). They often require structured information systems related to data management, enabling information and communication. These include technology-based infrastructures such as grid, computing, software and middleware. [European Roadmap 2006, 16]

This definition is fairly typical, and the full report is typical in the sense of providing enumerations of different types of technologies and research infrastructures. There is no simple way of defining *research infrastructure(s)* or *cyberinfrastructure* as the terms are part of a social, institutional and political context. Indeed, if we look at the term *infrastructure* itself, it broadly refers to “the resources (as personnel, buildings, or equipment) required for an activity” as well as “the underlying foundation or basic framework (of a system or organization)” [Merriam-Webster 2010]. [Edwards et al. 2009, 365] state that the term often “connotes big, durable, well-functioning systems and services, from railroads and highways to telephone, electric power, and the Internet.” 11

In practice, the notion of research infrastructure carries with it a number of assumptions that are partly linked to funding structures and the idea of infrastructure as a resource of national or international interest. Research infrastructure is typically taken to be advanced, costly, require national or pan-national funding, be associated with leading research and researchers, be part of a system, have use beyond single research groups or disciplines, have longevity, and add significant new research possibilities. 12

In general, much discussion of cyberinfrastructure is technology-driven, data-driven and structural-level. This is partly a result of the selling of a new generation of research infrastructure (cf. [Borgman 2007]), and partly a result of the emphasis on the traditional infrastructural needs of science and technology. Just like with *digital humanities*, the relatively high level of abstraction of a term such as *cyberinfrastructure* allows for descriptions not grounded in specific disciplines as much as in a set of high-level epistemic and technological commitments: 13

> OCI supports cyberinfrastructure resources, tools and related services such as supercomputers, high-capacity mass-storage systems, system software suites and programming environments, scalable interactive visualization tools, productivity software libraries and tools, large-scale data repositories and digitized secientific data management systems, networks of various reach and granularity and an array of software tools and services that hide the complexities and heterogeneity of contemporary cyberinfrastructure while seeking to provide ubiquitous access and enhanced usability. [NSF2010]

As Borgman observes, cyberinfrastructure is often defined through example, typically emphasizing the “integrative, collaborative, and distributed nature of new forms of research” [Borgman 2007, 22–23]. In addition, there is frequently an assumption of very large and complex data sets. While we do not necessarily need to question these assertions, it is important to note that we are concerned with a particular type of discourse and epistemic framework. This implies that a possible humanities alignment with cyberinfrastructure in this sense is, in fact, also an alignment with this discourse and with associated assumptions. For instance, distributedness in the sense of optiputers or grid computing is far more likely to be seen as cyberinfrastructure than multi-modal communication, data exchange and analysis through small-scale qualitative data bases, twitter and on-screen virtual worlds. Another assumption is that cyberinfrastructure is quite costly. This is not to say that humanities based cyberinfrastructure may not be quite costly, but rather to suggest that the structure, epistemics and cost structure of humanities based cyberinfrastructure may be different than that of science and engineering based infrastructure. These assumptions are real in the sense that they influence the way humanities research infrastructure is being imagined and built. 14

Research infrastructure seems to easily acquire a status and life beyond *only* supporting or facilitating research. Importantly, research infrastructure is not research (cf. [Rockwell 2010]), and it seems appropriate that research needs and challenges shape the establishment of new infrastructure. In the case of the humanities, we are thus primarily concerned with research challenges and infrastructural needs identified by the humanities, and in particular, humanities researchers. A few possible examples include: embodiment in digital environments, transformation of urban spaces through media technology, tracing narrative structures in computer games, the use of map based visualization to find patterns in large sets of archival information, text mining technologies for literary and linguistic analysis, and understanding reading comprehension with the help of eye tracking equipment. 15

However, the nature of infrastructure and funding mechanisms make the process more complicated than matching one identified research challenge with an appropriate piece of infrastructure. In practice, infrastructure often has to be relatively abstractly framed and typically serve more than one specific need in order to qualify as infrastructure. Technologies such as visualization and grid computing fulfill this requirement, and they often come across as *black boxes* rather than sites of situated research facilitation. Furthermore, funding is much more likely if the infrastructure is associated with ‘new’ research and major projected advances. There is also a push for interdisciplinary research endeavors. This means that there is a visionary, cross-sectional and experimental component to many infrastructural projects. 16

Research Infrastructure for the Humanities

The discourse and practice of research infrastructure are strongly situated in science and engineering, and typically concerns technology and systems that require national or pan-national funding. Examples include high performance computing, grid computing, and facilities for synchrotron radiation and biomedical imaging. Also in cases when national funding sources in principle are open to all areas of research (including the humanities), there is a strong tendency to mainly fund science, engineering and medical research. For instance, the Swedish Research Council gave out 40 infrastructural grants in 2009 for equipment, running costs for infrastructure and large databases, and none of these grants had an obvious humanities focus or humanities based principal investigator, although one or two grants were given to quantitative social science projects. Clearly, the humanities have not been seen as a significant player in this kind of funding schemes apart from in certain areas (e.g. computational linguistics, environmental archaeology and digital libraries), which also means that the specifics of humanities infrastructures are rarely elaborated on, and there is relatively little discussion of what humanities infrastructure in this sense could actually be. 17

As was noted above, there is an acknowledgement and push for the importance of better and more research infrastructure for the humanities — not least in the digital humanities. This process is strongly linked to a realization that material, tools and culture are becoming increasingly digitalized, and that academic work is increasingly being carried out in a distributed and digitally supported fashion. The background is also a relatively recent move towards a *new* generation of research infrastructure often called cyberinfrastructure (in the US), e-science (in Europe and Australia) or simply research infrastructure (e.g. Canada), which draws on computational resources, distributed work and a more inclusive notion of infrastructure. [Rockwell 2010] describes this movement as an “infrastructure turn,” while funding agency reports and other sources often describe it as a revolution (e.g. [Green 2007]). At least in terms of how it is presented, infrastructure in this sense is more likely to include human resources and other non-technical aspects than earlier generations of infrastructure. Nevertheless, the whole movement is essentially a science and engineering driven enterprise: 18

> The Panel’s overarching finding is that a new age has dawned in scientific and engineering research, pushed by continuing progress in computing, information, and communication technology; and pulled by the expanding complexity, scope, and scale of today’s research challenges. [Atkins et al. 2003, 31]

The use of *new* in this influential National Science Foundation Blue Ribbon Report is not accidental; the discourse of cyberinfrastructure is one of *new, emerging* and *expanding*. [Borgman 2007, 30] states that there are 133 instances of *new* in this report, and most other similar documents show the same trait. The ACLS Report on Cyberinfrastructure for the Humanities and Social Sciences [Unsworth et al. 2006] reportedly uses 89 instances of *new* in 64 pages. These figures suggest that “newness” may be a useful prerequisite for (funded) cyberinfrastructure. 19

The National Science Foundation Report only mentions the humanities explicitly once (in relation to digital libraries), but nevertheless there is clearly an interest in engaging with the humanities and social sciences despite the NSF’s focus on science and engineering. Similarly, in many accounts of cyberinfrastructure there will be a note about the impact on these *non-primary* areas. 20

> Although our focus is on e-Science, other research fields such as the social sciences, arts, and humanities will also require and benefit from this emerging cyberinfrastructure. [Hey & Trefethen 2008, 15]

It may be argued that statements like these are somewhat external to the humanities in that they often make outside assumptions about the needs, requirements and priorities of the field. In order for the humanities to control our own cyberinfrastructure, we need to express humanities-driven needs and engage in constructive dialogue about our current and future infrastructure. 21

Risks and Strategies

There are risks, however, that need to be addressed in this dialogue. First, existing humanities infrastructure may be disregarded as we do not have a tradition of science-like infrastructure. Second, the science-based and data-driven model may be imposed on the Humanities (sometimes by humanists themselves) without careful discussion of the premises and consequences. Third, there is a risk that infrastructural needs or agendas compatible with the largely science based model will be the ones most likely to be prioritized. Fourth, new humanities infrastructure may be uncritically based on existing infrastructure and associated epistemic commitments. 22

The position taken in this article is that the current investments and interest in cyberinfrastructure and e-science for the humanities present an opportunity to think carefully about what the humanities need and may not need in terms of infrastructure (broadly interpreted). This cannot be done, however, if we cannot maintain a critical stance and advocate a truly humanities based approach to academic infrastructure. At the same time, we need to acknowledge that we do not necessarily know what kind of infrastructure we need and will need, and that it is important to simultaneously engage in the exploration of humanities based research issues and challenges, and in the exploration of technology and different kinds of infrastructure (including infrastructure that is part of science and engineering cyberinfrastructure). Consequently, we must allow for both technology and humanities induced visions and implementations in different kinds of combinations. 23

Furthermore, we have to be aware of the fact that any investment in cyberinfrastructure is likely to be a prioritization and that certain parts of the humanities are more likely than others to be good candidates for such investments. It is important, however, that this prioritization is not a direct consequence or transfer of a predominantly science and engineering model of cyberinfrastructure and that it is not uncritically based on existing infrastructural traditions. Importantly, cyberinfrastructure is not neutral. In the following, we will look at three models for humanities research infrastructure, which exemplify the non-neutrality of cyberinfrastructure: existing infrastructure as a model, the humanities having no or little infrastructure, and a technology and science driven model. 24

Existing infrastructure as a model

The humanities have made use of research infrastructure in scholarly practice from early on, and for instance, libraries and archives are often pointed out as essential infrastructure to the humanities. Indeed, some writers claim that the humanities themselves make up vital infrastructure (e.g. [Swedish Research Council 2007], 2009-2012), or cultural infrastructure can function as trading zones between technological, artistic, and humanities practitioners (see [Turner 2009] on Burning Man as a cultural infrastructure). A related model is that of network forums as emergent structures that blend cultural and infrastructural networks (see [Turner 2005] on the WELL). 25

One descriptive model states that there is considerable humanities research infrastructure already in place and that this infrastructure is a very good candidate for becoming cyberinfrastructure or being digitalized: 26

> The infrastructure of scholarship was built over centuries. It includes diverse collections of primary sources in libraries, archives, and museums; the bibliographies, searching aids, citation systems, and concordances that make that information retrievable; the standards that are embodied in cataloging and classification systems; the journals and university presses that distribute the information; and the editors, librarians, archivists, and curators who link the operation of this structure to the scholars who use it. All of these elements have extensions or analogues in cyberinfrastructure, at least in the cyberinfrastructure that is required for humanities and social sciences. [Unsworth et al. 2006, 6]

While this is probably a valid description of existing infrastructure (but cf. [Rockwell 2010]), it largely leaves out infrastructures outside of libraries, archives, museums and publication systems. It could be argued that we are concerned here with a library and collection based model – admittedly well in line with a large part of the humanities. It is important to realize, however, that there is a set of epistemic commitments associated with this model – pertaining to structure, delivery, material types, retrieval systems, selection procedures, relation between researchers and library institution and other issues basic to the humanities – and that any major new investment in cyberinfrastructure should not uncritically be based on such, existing structures and descriptions. For instance, it would seem that the model presented above makes a fairly strong delineation between the collections (institutions, distribution systems, professional functions involved, etc.) and the researchers and the research community. Drucker addresses such delineations critically: 27

> The design of new environments for performing scholarly work cannot be left to the technical staff and to library professionals. The library is a crucial partner in planning and envisioning the future of preserving, using, even creating scholarly resources. So are the technology professionals. But in an analogy with building construction, they are the architect and contractor. The creation of archives, analytic tools, statistical analyses of aggregate data in humanities and social sciences is work only possible with the combined expertise of technical, professional, and scholarly personnel. [...] Modelling scholarship is an intellectual challenge, not a technical one. I cannot say this strongly or clearly enough. [Drucker 2009]

In contrast to much of the discourse of cyberinfrastructure and digital humanities, Drucker focuses on the scholarly challenge 28 and not on the technology or technology-induced visions. However, the terms on which this analogy is constructed reinforces specific roles, and the term *contractors* may be seen to mark an implicit class distinction and clear institutional positions. A related question is whether new institutional roles will develop, and whether these will blur the roles described by Drucker and the ACLS report. Along these lines, Blackwell and Crane call for institutional change:

> […] [W]e need new institutions to provide access to the results of our work. Neither the libraries nor the publishers of the early twenty-first century serve the needs that emerge in this collection. While libraries may survive and indeed flourish as an institution, they will do so by subsuming and transforming the functions that we entrusted to publishers in print culture. [Blackwell & Crane 2009]

The library as a model is hence not static, and as Blackwell and Crane's example illustrates, we need to be careful about not uncritically modeling tomorrow's research infrastructure on past or current infrastructure. 29

The Humanities Have no or Little Infrastructure

There is a sense that traditional humanities have very little need of research infrastructure and, at the same time, a partial realization that that the needs may be changing. This is an argument sometimes put forward by the digital humanities community: 30

> Despite a slow and uneven uptake of digital technology in some areas of the Arts and Humanities research, the discipline is no longer based on pen and paper. Specific individual needs of research that relies on the use of advanced technologies must be better understood and matched by a level of support that is already enjoyed by the scientists. [Bentkowska-Kafel 2007]

This kind of reasoning to some extent reinforces the sense of "basic" humanities being mainly reliant on technologies such as pen and paper, and it is by no means a new argument (see e.g. [Roper 1991, 131]). More broadly, however, the view of basic humanities as without, or little, significant infrastructure not only assumes a science and technology based idea of what makes up infrastructure, but also imposes a "pen and paper" construction of the humanities. Pen and paper, while inherently communicative and collaborative, are also linked to the assumption that humanities scholarship to a large extent is a solitary endeavor (the individual scholar in his or her study): 31

> Humanities scholars often work alone without collaborators or assistants. In contrast to the cooperative efforts common in the sciences and social sciences, humanities scholarship is the result of solitary research and thought. [Burnette et al. 1994, 182]

Obviously most humanities research is not at all solitary (cf. [Grafton 2009, 2–5]), even though authorship is often attributed to one person. Moreover, there can be no doubt that there is research infrastructure in the humanities and that it has a long history. One possible consequence of construing the humanities as not having much infrastructure and being a solitary enterprise is a higher readiness to adopt science and engineering models of cyberinfrastructure (as if there is "nothing" there to start with). 32

A Technology- and Science-driven Model

When a science and engineering framework is taken to the humanities and social sciences, there will often be attempts at aligning specific toolsets and technologies with the subject areas in question and here, the starting point will often be the technology. A fairly recent example is grid computing (see e.g. [Bonnett, Rockwell and Kuchmey 2008]). Questions asked may be: What can grid computing do for the humanities? What large humanities data sets are particularly suitable for grid computing applications? The gap between high performance computing perspectives on grid computing and humanities based research issues and questions can be very large, and in facilitating meetings between the two, it is critical to create a common discursive space and allow time for dialogue. A good example of deep thinking about this process is provided by the report "Mind the Gap" [Rockwell & Meredith-Lobay 2010], in which it is argued that currently, the main gap between High Performance Computing and research in the humanities relates to research culture and support. 33

> On the one hand we have to find ways of training and preparing humanities research teams to be able to imagine using existing HPC facilties, and on the other we have to develop the ability of HPC consortia to be able to reach out and support. [Rockwell & Meredith-Lobay 2010]

One recommendation in the report concerns the necessity of humanists being involved early in the process (also in management and decisions). There is a balance between discipline and technology driven issues and questions, and finding this common ground is not trivial. Importantly, we also need to acknowledge that “technological competence” can be very diverse, research intensive and complex. Indeed, since the discourse of cyberinfrastructure has a tendency to take place at an aggregate level in relation to complex and internally diverse entities such as the humanities or science and engineering, it would seem that real, grounded encounters can be particularly valuable. 34

On a more abstract level there is a concern with aligning cyberinfrastructure as a project with the humanities and social sciences: 35

> Humanities scholars and social scientists will require similar facilities but, obviously, not exactly the same ones: “grids of computational centers” are needed in the humanities and social sciences, but they will have to be staffed with different kinds of subject-area experts; comprehensive and well-curated libraries of digital objects will certainly be needed, but the objects themselves will be different from those used in the sciences; software toolkits for projects involving data-mining and data-visualization could be shared across the sciences, humanities, and social sciences, but only up to the point where the nature of the data begins to shape the nature of the tools. Science and engineering have made great strides in using information technology to understand and shape the world around us. This report is focused on how these same technologies could help advance the study and interpretation of the vastly more messy and idiosyncratic realm of human experience. [Unsworth et al. 2006]

There is, again, a risk here of adopting a science and engineering based model for humanities infrastructure in such a way that it significantly constrains and shapes possible research enterprises and directions. The question is also whether it is at all possible to discern a point like the one referred to in “only up to the point where the nature of the data begins to shape the nature of the tools”. It may be argued that this point occurs very early and that there is more at play here than the nature of the data. It could be argued the alignment described in the ACLS report is simply not feasible. As Sterne points out, “disciplines never fully constitute their objects; they fight over them” [Sterne 2005, 251]. He argues that these fights are partly what make disciplines maintain their intellectual vibrancy. If the range of data and the study objects are in question, it may be difficult to *process* data up to a certain point and use generic tools without early involvement from researchers. Furthermore, it could be argued any data would already be part of an information and knowledge infrastructure that is relevant to knowledge production and creation of tools and technology: 36

> Information infrastructures such as databases should be read both discursively and materially; they are a site of political and ethical as well as technical work; and that there can be no a priori attribution of a given question to the technical or the political realms. [Bowker 2005, 123]

Broadly conceived, cyberinfrastructure is intertwined with various institutional, social, cultural and historical layers inside and outside the disciplines themselves. As research infrastructure often, but not necessarily, supports interdisciplinary work, it seems particularly important to situate data structures, standards, technologies, knowledge structures and tools in a broad epistemological context. This is even more important given that infrastructures have a tendency to become invisible over time and that scalability is a commonly assigned property of cyberinfrastructure [Bowker & Leigh Star 1999, 33]. 37

There is a risk that external pressure on the humanities, not least the digital humanities, leads us to a positivist, results-driven approach. Here the need to provide motivation for funding agencies and university administration unsurprisingly plays an important role: 38

> I'd just like to chip in and say this is what the funding councils are calling *Evidence of Value* — and are asking us to show evidence for the value of digital humanities research. It's important, as funding cuts in this area (such as the withdrawal of funds for the AHDS) are based on the perceived lack of evidence of value. Unless we can articulate, as a community, the better/faster/more nature of digital, we will struggle even harder for funding in years to come. [Terras 2009]

The choice of adjectives here — “better/faster/more” [Terras 2009] — suggests a view of the digital humanities and associated infrastructure in line with the positivist discourse of science and technology driven cyberinfrastructure discussed above. The context is a dialogue about “making a difference” and “What difference does digital make?” [Terras 2009]. While the above excerpt is very short and informal and we should not make too much of it, it is nevertheless noteworthy that it does not provide 39 arguments that bring in research issues or current disciplinary challenges, which would seem indicative of the methodological and technological focus of traditional humanities computing.

Implications and Stakes

At a time when there is both external pressure to specify infrastructural needs for the humanities and a growing humanities-internal interest for academic infrastructure and for the *digital,* it is clear that the ways we articulate and implement cyberinfrastructure for the humanities have strong implications. What happens if we do not explore multiple visions, focus only on digitizing existing infrastructure, or let the agenda be set through a technological focus or a model strongly based in the sciences? 40

Here the question of epistemic commitments (cf. [Svensson 2009]) clearly comes into play. A too singular vision of cyberinfrastructure will limit the players and participants to those who match the epistemologies embedded in the new infrastructures, likewise a narrow focus on extending current infrastructure may result in a kind of *epistemological conservatism* that would foreclose potential new ways of knowing and legitimizing knowledge. Equally, a technology and science-inspired model driving the agenda could result in a cyberinfrastructure for the humanities without strong grounding in the disciplines, knowledge production, and indeed, needs and interests of the humanities. Furthermore, there is also the risk of what may be called epistemic double-binds (following [Ratto 2006]) where humanities researchers who want to make use of the new technologies are caught between the commitments of their academic disciplines and those of engineering, computer science and science more broadly. Ratto's principal example concerns use of computer-supported visualization and modeling in classical archaeology, and how three groups of scholars and scientists — for different reasons grounded in different epistemic commitments — rejected a project where an immersive 3D environment was used to question traditional understanding of the use of terra cotta materials in a particular form of pre-Roman temple. Ratto importantly argues that 41

> [a]cknowledging these commitments can help us develop appropriate technologies that help rather than hinder existing research practice, add a layer of reflexivity to researchers' choices and decisions, and ultimately, facilitate productive cross-disciplinary collaboration [Ratto 2006]

Given the cyberinfrastructural push and the considerable interest in establishing new initiatives for the digital humanities, there is currently a window of opportunity. This window of opportunity needs to be combined with critical engagement to establish good practice, explore possible models and have a cyberinfrastructural dialogue across the Humanities. 42

Part II: HUMlab as a Case Study

Introduction

As we have seen, the discourse on research infrastructure frequently becomes abstract and undetailed. At times, it is also positivistic and seemingly unsituated. At close quarters, on the other hand, infrastructure is often very concrete and material. The step from this material quality, as exemplified by a strand of optical fiber or a database server, to the conceptual underpinnings of research infrastructure, e.g. the ideas underlying a digital humanities initiative can be very substantial. In the following section, it is suggested that it can be helpful to look at the underlying ideas and the material qualities as well as intermediate level design principles that mediate ideas and infrastructure. 43

In order to connect ideational grounding, design principles and actual implemented infrastructure, the case study of HUMlab, a digital humanities laboratory in the North of Sweden, will be examined in detail, as a particular example of humanities cyberinfrastructure. The case study was partly chosen because of the current author’s intimate knowledge of it, but also because it serves as a fairly distinct example of digital humanities infrastructure. Needless to say, it is only one example of infrastructural implementations, and as most infrastructures, highly situated in a particular context. 44

Framing the Case Study

HUMlab is situated in a comprehensive research university, Umeå University, and as a ten-year endeavor, it has just undergone a major expansion supported strongly by the university as well as several external funding agencies. HUMlab has a commitment to a wide range of different modes of engagement which, naturally, affects infrastructural needs and visions. At this particular point in time, the university has taken a decision to build a new artistic campus — Umeå Arts Campus — by the river not too far from the main campus. Here the Institute of Design, the Academy of Fine Arts, BildMuseet (museum for contemporary visual arts) and a new School of Architecture will be situated, in addition to the new HUMlab-X. HUMlab will be 45 the only institute or department to have a clear presence on both campuses.

As noted above, there is evidently a considerable gap between the visionary, often positivistic and unsituated, discourse on cyberinfrastructure and implemented, and often quite material and situated, infrastructure. The connection between the two seems weak at times, and as we have seen, the conceptual underpinnings of cyberinfrastructure and associated epistemic scope may not be clear or explicated. At the same time, seemingly small decisions about technical or constructional details can have a very real impact on potential use and research possibilities afforded by the infrastructure. 46

Through looking at implemented infrastructure, how it came about, ideational grounding and actual use, we can get a better sense of the complexity of the process and hopefully suggest a model that makes the concept of cyberinfrastructure richer, at the same time as linking to actual infrastructure. In the following, a model which includes conceptual cyberinfrastructure, design principles and actual cyberinfrastructure will be explored in relation to a particular infrastructural example. 47

There are many possible infrastructural needs for a digital humanities lab or any digital humanities enterprise. These needs are partly connected to the modes of engagement discussed in the second article in this series [Svensson 2010]. For example, if the primary mode of engagement is technology as tool, you are likely to have rather different needs from an enterprise where the digital as a study object is the main focus. Patently, there are a great many different possible implementations for any digital humanities related enterprise dependent on factors such as the specific context, visions and epistemic scope. 48

It is worth stressing the wide range of possible implementations within a single mode of engagement such as technology as tool. One example may be a research environment interested in experimental work using eye-tracking equipment or phonetic experiments in an echo-free room. These various facilities could possibly be manifested in several separate (but probably co-localized) rooms. Another example could be an institution focused on digital cultural heritage and the use of heavy-duty databases for making cultural heritage accessible to researchers around the world. Here the database servers would not necessarily have to take up any lab space at all as they would probably be housed in a server hall somewhere. Much of the work could then be carried out in individual offices or in a small lab space with workstations and space to help facilitate collaborative projects. A third example may be found in the tool-building phase of a large-scale research project where the digital component was a small part of the whole project. Here the facilities and equipment used may be part of that larger research project, or there might be some general resources for certain tasks. Importantly, all of the above examples require resources beyond the technology proper, and high-level competency is often needed. For instance, it does not make much sense to invest in high-end eye-tracking equipment if you do not have staff or researchers invested in methodology, technical management and maintenance. For more extensive use, and higher return on investment (i.e. higher and more “efficient” use), it is unsurprisingly advantageous to have dedicated people and resources connected to the infrastructure. 49

The installation we will now look at has a more general, multipurpose character beyond the needs of single research groups, disciplines or methodological areas. HUMlab is a physically grounded studio environment heavily dependent on distributed work, international collaboration and reaching out. My knowledge from this institution comes from personal engagement and directorship, and while this inside perspective certainly calls for methodological concern and care, it also brings long experience from building, developing and incorporating a particular institution and its associated cyberinfrastructure. 50

Introducing HUMlab

HUMlab at Umeå University, Sweden, is a digital humanities center whose main physical manifestation is a 500 m^2 (5,500 square feet) studio space at the center of the campus below the university library. This location is ideal because of its centrality and because it is seen as a neutral space not associated with any particular school or department. It is also a space with history and certain, irregular physical qualities that seem to help create an engaging and attractive environment. 51

The basic idea behind HUMlab, as articulated early on, is to facilitate the meeting between humanities, culture and information technology, or put differently, to be a meeting place for the humanities, culture and information technology. Being a collaborative and intersectional *place* is critical to the operation. This fairly simple idea makes up a strong ideational basis, which is evident in the lab’s documentation from the very beginning up to this point. At the same time, it is not very concrete in the sense of detailing out implementations and constraints. This has allowed a fairly dynamic development and a relative openness to ideas and initiatives. 52

The roots of this fairly independent role can partly be found in the lab’s origins. HUMlab was established in the late 1990s as a result of a discussion at the humanities faculty that started around 1994-95. The earliest incitement was the fact that the 53 analogue language laboratory (mainly for teaching language pronunciation and proficiency) was gradually breaking down, and an early response was to try to devise some kind of multimedia lab. The resultant application for external funding was not successful, but had it been, the new lab would probably have been fairly traditional and instrumental. The failed attempt to secure funding led to the faculty seeking help elsewhere, resulting in a multiple-year process and ultimately to a very different concept. This concept, the meeting place mentioned above, partly came from outside the faculty and through working with a senior and creative officer at the university-wide IT function, the faculty secured technological validity, administrative know-how and an outside perspective on the humanities.

The resultant project application rendered some early external funding for equipment in 1998, and a decision was taken to support the lab at a faculty board meeting in November 1998. It is noteworthy that the faculty board, despite the secured external funding for equipment and a fairly long internal process, was quite divided. The decision was positive but it took the decisive vote of the chair of the board to settle the matter. This hesitancy is possibly unsurprising, giving the “newness” of the enterprise and that any decision of funding is implicitly or explicitly a matter of prioritization. Also, investments in infrastructure or continuously paying for maintaining an infrastructure outside the traditional commitment of a faculty brings up important questions about long-term costs and the extent of financial and institutional commitments. 54

The Space

The idea of having a lab or studio space was part of the concept from very early on. Indeed, as we noted above, it all started as a concern with an old language laboratory and a possible multimedia replacement, the spatial need and having a lab could be seen as part of the original epistemic setup. It was taken further, though, in the subsequent discussions of HUMlab. There is a significant difference between a more moderate lab space and the large space that was envisioned and later allocated for HUMlab. This may partly have been a consequence of the focus on HUMlab as a meeting place and a diverse studio space with many different technologies and approaches. Moreover, HUMlab was described at an early stage as a *playground* - a place for exploring, testing ideas, connecting with outside initiatives and materials, and playing with technology - and this may have added to the sense of needing substantial space. 55

The characteristics of the available space played an important role. After some negotiation, HUMlab was offered an old space below the university library. For many years, the long-term goal, supported by the university management, was to secure another space (newly built), but it has gradually become more and more obvious how well the existing space works. The location is critical, and a new, nice space at the periphery of the campus would most certainly not work as well as a meeting place. Also, the quirkiness, character and history of an old space plays an important role, as exemplified by the pillars, the irregularity of the space, the basement position and its earlier function as an exam hall. We will return to these elements shortly. 56

HUMlab as a physical playground and meeting place is very much grounded in ongoing activities, lab life, meetings and technology. This physical presence extends into various digital environments and the two spaces of activity are richly interlinked. Most of the activities and projects are distributed in one sense or another. For instance, one of the first projects in the lab (started in 1999) a three-year student based exploration and expression in a virtual world hosted by HUMlab [Svensson 2003], and since then, there has been lively engagement with a range of virtual world platforms. Most of the projects to do with digital cultural heritage have a presence in the physical lab, but much of the core operation occurs in relation to distributed databases and tools in international teams. Another example of merging of physical and digital is a fairly recent interest in physical computing. One of the 2008-2009 digital art fellows ran an operation called Ms. Balthazar’s Laboratory, a physical computing workshop for artistic uses intended primarily for women, with continuous meetings in HUMlab. The collaboration and workshops continue after the digital art fellow has left Umeå. Another fellow facilitated a process of community creation and curation that led to the exhibition of the Open Source Embroidery Project in 2009 in HUMlab and the BildMuseet. This exhibition opened in San Francisco in the winter of 2009, and it also reverberates in the lab through new courses and other activities. 57

Organization and Collaboration

In terms of organization, HUMlab is a unit directly under the Humanities faculty and in most respects structurally comparable to a department. HUMlab can employ faculty as well as staff, and the director of the lab has roughly the same role as a head of a department. There is no formal research discipline associated with HUMlab, which means that Ph.D. students are affiliated both with HUMlab and a department. Faculty can be employed and tenured (in the European sense) by HUMlab. There are many possible organizational models, of course, but in many respects this particular organizational position seems advantageous. For one thing, there is little risk that HUMlab becomes too much associated with one department. HUMlab works with all humanities departments and disciplines (but in different ways and to varying extents). A higher organizational position such as a being a 58 university level unit may be useful in some respects, but the risk may be that you lose disciplinary anchorage. Furthermore, because of the unit's relative independency and multiple modes of engagement with information technology, there is little risk that HUMlab becomes classified as a service unit (a kind of unit normally prone to restructuring and financial rationalization; cf. [Flanders & Unsworth 2002]).

An important part of HUMlab as practice is broad collaboration within and outside the humanities faculty. It is vital that HUMlab has had (or taken) a mandate to work extensively with other parts of the university, artists, companies and others interested in collaboration. Often these collaborations function as a way of creating collaborative opportunities for humanities researchers, students and departments. Importantly, HUMlab presents itself as being dynamically built on such collaborations rather than as a distinct and self-sustained research center. This is probably one of the reasons why there is strong support for a new HUMlab on the new Umeå Arts Campus. There was clearly an interest in having parties who not only engage in collaboration, but whose main function is to facilitate collaboration and interdisciplinary meetings (and in a way are dependent on rich collaboration for success). 59

It may be argued that a chief difficulty in growing digital humanities is finding modes of scholarship that enable young researchers to inhabit the often problematic in-between zones. HUMlab attempts to balance interdisciplinarity within a collaborative zone with a grounding in departments and disciplines. This allows a range of strategies to grow. Further, it provides migration in discourses between interdisciplinary zones and centers of traditional academic departments and enables solidarities to arise in communities across departments, thus helping structure a field of research, and does not force young scholars to compromise between conservative choices for career and their interest in speaking to the contemporary moment. 60

An early strategic decision that shaped HUMlab and associated cyberinfrastructure is that access is not restricted to specific groups and that the lab is open to students, faculty and staff as well as outside participants (a consequence of the basic idea of meeting place). Hence there is no exclusive focus on research, rather a continuous cross-fertilization between education, research and development work. HUMlab was designed to allow several simultaneous activities, and normally, a single activity cannot monopolize the lab. For instance, this means that a teacher using HUMlab for a class cannot ask other people to leave the lab (unless they are obviously disturbing the teaching), and that interaction between groups and individuals is encouraged. The difference between a regular classroom and HUMlab is quite pronounced, while some teachers may initially be uncomfortable with HUMlab as learning environment, most seem to appreciate the dynamics and energy of the lab. A common reaction if you enter the lab for the first time – not least students – is one of (positive) surprise and some bewilderment. 61

The Importance of Spatial Configuration and Designing Space

The interrelation between the space, technology and design is key to the actual implementation of a digital humanities environment whether it be physical or digital. Space and design cannot be divorced from technology and intellectual milieu (cf. [Livingstone 2003]); they are indeed important parts of what makes up cyberinfrastructure. 62

The physical lab space of HUMlab was originally an examination hall and is situated in the oldest part of the university – below the university library and the central rotunda. The basement location gives the lab a certain atmosphere (cf. [Williams 2008]), which is reinforced by approaching the lab though a tunnel of protruding pipes, cement walls, sounds from the pipes, echoes in the corridor and muted noise from the students above. An interesting contrast is created between this subterranean feel, with some of the edginess and rawness associated with the "underground," and the "warm" inside design of the lab. 63

Figure 1. Photo of HUMlab (original lab space)

The foundational function is further evidenced through 24 pillars and the rotunda, whose protruding base forms one of the inner 64
walls. The ceiling height is not the same throughout the space and in general, the space is fairly irregular. The original lab space is about 280 m^2 (3000 square feet). It contains a closeable inner space with large windows and the lab’s computer workstations are mainly organized around pillars (as “islands”). Together with the aforementioned glass room, a meeting section behind a bookcase and an area with couches and an aquarium, the islands make up an important part of the lab space. There are quite a few screens in the space, mostly private workstation screens, but also several display screens. Many of the private screens are in fact fairly public as the space has been designed to encourage people to relate to each other’s work. In this way, there is a simultaneous production of a shared sense of publicness, co-location and semi-private space (cf. [McCarthy 2001]). Other screens consistently work as portals to projects and other physical and digital spaces.

Although a rather untraditional lab environment, the old part of the space has some elements associated with traditional 65
computer lab spaces, including the computer workstations described above. When HUMlab was expanded in 2008 with an additional 220 m^2 (2400 square feet), the new space was designed with considerably more flexibility than the old part. In a way, the two parts represent fairly different implementations and concepts within a common framework. The function of an open meeting place is quite pronounced in the new space. At the center is “a room in a room” defined by wallpapered pillars, a rug and a large central table, and all these parts can be removed or reconfigured. The rest of the space is fairly open in its basic configuration. An important property of the new lab space is a screenscape that includes a number of public screens around the space. There are ten large flat screens (57"-70") and one very large, back projected high resolution (4K) screen. The large screen has multi-touch functionality and there is a spatial audio system which covers the screenscape in its entirety. The basic idea is to afford rich contextualization, and partly collaborative and partly distributed work in a fairly large interaction space. The arrangement of the screens is quite significant and their placement at the periphery of the space in combination with the centrally placed table prevents the screens from dominating the space.

Figure 2. Photo of HUMlab (part of the screenscape and the expanded studio space)

These public screens are simultaneously individual and part of the screenscape, and they structure and break up the space in certain ways. Participants in the space can be situated in relation to individual screens or in the context of the full screenscape, as well in ongoing activities or conversations. [McCarthy 2001] discusses some of these complexities in relation to multiple overhead monitors: 66

> Serial spectacles on overhead screens both symbolically join spaces together in long-distance communication and fragment the social atmosphere of their immediate environments. The connotations of public address that come with the convention of overhead screen placement suture the conversing spectator into (at least) two places at once. [McCarthy 2001, 124]

While the screens in the HUMlab screenscape are not placed in an overhead position (but rather mid-level), they certainly both fragment and join the space together. The space and technical setup encourage experimentation with different configuration and uses. 67

Behind the screen perimeter there are a number of workplaces and workstations for different research areas and for visiting scholars. Here the large screens mounted on pillars help separate the screenscape from the more private area behind the pillars, while maintaining a sense of communication in between the more public and the more private zones. One of the sections behind the pillars has a combined whiteboard and projection screen that is not part of the screenscape and which allows a small research group to collaboratively and semi-privately use the screen and associated technology. 68

There can be no doubt that the ways cyberinfrastructure is constructed and implemented have direct bearing on knowledge production and the epistemic scope of such infrastructures, and that space, physical and digital, is often a carrier of cyberinfrastructure. There is rich meaning to how space and infrastructure are configured, juxtaposed and used far beyond the purely functional or technical properties of the infrastructure. The following set of quotes illustrates this point in relation to a traditional humanities infrastructure - the library. 69

> I'm surprised to realize how much my identity as a humanist at MIT is tied to Building 14, how strong its symbolic importance as a space for humanities books and humanities teachers.
>
> I think that a Humanities Library should be a kind of intellectual hub for humanities scholars and students. It should house books, of course, but also humanities events, humanities computing resources, etc. Humanists should be able to gather there to exchange ideas. The library is our lab. And our food trucks,

> minus the food.
>
> The best place for writing for me is by the big windows in the Humanities Library, with the network drop nearby. All I ask for is some newer tables, and maybe more ergonomic chairs.
>
> The Humanities Library is an oasis in an otherwise inhospitable desert. It provides the Humanities with a dignity that is not accord else on this campus, and therefore sustains me in my sense of intellectual and academic worth on a day-to-day basis. [HASS 2001]

These comments were collected in the beginnings of the 2000s, when there was a discussion of the future and location of the humanities library at MIT. The comments mainly come from faculty, and here we get a sense of the richness and interconnectedness associated with conceptual grounding (the library as idea, meeting place and hub), design (e.g. the big windows and the network drop), location, personal engagement with the infrastructure, power structures and disciplinary perspectives. 70

It is thus important to carefully consider how we design these spaces or infrastructures and how they relate to both the technological level of infrastructure and conceptual grounding. This may be where we find the kind of articulation and "packaging" required to address the challenge we outlined in Part I of this article: the need for humanities based visions of cyberinfrastructure. 71

A rich full-length study of the complexities of cyberinfrastructure in relation to space and conceptual notions can be found in Reinhold Martin's analysis of corporate architecture in the United States after the Second World War [Martin 2005]. He traces how cybernetics and a systems-based theory in architecture come to create flexible and modular interiors. In his analysis of IBM and the IBM Rochester's plant - designed by architect Eero Saarinen - that opened in September 1958, Martin points to how the architecture of modular blue patterns was used to "displace (or dissimulate) the social hierarchies written into white collars and gray flannel, in the name of 'human relations' among mass-produced IBMers" [Martin 2005, 170]. One example of this is the visitors' entry not being seen as more important or architecturally pronounced than the entries to the employees' pavilions. Martin traces the parallels between the design of devices such as the IBM 305 Random Access Memory Accounting Machine (RAMAC, released in 1956) and the corporate buildings of IBM. He points to the analogy between human nervous systems and computer design, and associated neurological terminology made prevalent by John Neumann and others, and how this thinking may also become reflected also in the architecture. 72

> While IBM represented itself as a mere maker of business machines and "calculators," even its building were experimenting with "logical controls" encoded into a paper-thin skin. Even more than the RAMAC, this building's "brain" was on its surface. In that regard, its image was integral to the organizational strategies that kept the company growing and enabled it to expand its research into artificial intelligence, pattern recognition, and related arenas. [Martin 2005, 181]

These arrangements clearly have rich meaning, and it could be argued that such a reflective mode and sense of history and ideational grounding also helps us to better understand cyberinfrastructure for the humanities. 73

Conceptual Cyberinfrastructure

Conceptual cyberinfrastructure can be seen as a set of underlying ideas that provide the ideational grounding of a particular instance of research infrastructure. In the case of HUMlab, facilitating cross-sectional meetings is such an underlying idea. In the model presented here, these basic ideas can be related to design principles. For instance, the design principle of translucence (to facilitate both "see-through" and individual space) helps facilitate the idea of HUMlab as a meeting place. These principles, in turn, inform the implementation of actual infrastructure (for instance making extensive use of glass and not having any fully isolated parts of the lab). 74

In practice the flow will be iterative, and for instance, it is rarely the case that new space and infrastructure can be built without any constraints imposed from existing systems, architecture and research infrastructure, as well as existing funding regimes and/or policies at the administrative level. Such constraints (and possibilities) need to be presented and negotiated throughout the process. 75

While this model may seem ambitious for small installations and for conventionalized infrastructure (such as a traditional classroom intended to be used "traditionally" or a standard query system for a research database), it can be quite useful when 76 thinking about new kind of learning and research spaces and associated infrastructure. It encourages us to be clear about the conceptual underpinnings and epistemic scope, think carefully about how these can be translated into design principles and operationalized in relation to existing infrastructure and planned cyberinfrastructure. If successful, such a process would help us articulate our requirements, visions and ideas in a broad, contextualized sense and in relation to conceptual issues, as well as physical and digital implementation. Furthermore, it may help us create a meeting point for people from the "enterprise" (department, university administration, "users") and people involved in the creation of new infrastructure and space (architects, hardware and software specialists, contractors, property owners and sometimes also funding agencies).

Importantly, since the digital humanities maximally but not necessarily, incorporates many different disciplines, disciplinary pathways, modes of engagement, perspectives and outside pressures, it is quite important to be conscious of epistemic traditions and be deliberate about the process, vision and implementation. It is also important, however, to acknowledge that arriving at a conceptual foundation and implementation often is a complex, iterative and exploratory process, and that there are many possible paths. 77

In the case of HUMlab, it is quite clear that there has been a set of conceptual underpinnings that have shaped the emerging cyberinfrastructure from the beginning, although some of these may not have been articulated until quite late in the process. Other parts of the conceptual foundation have developed and changed over the years. Below, three significant examples are given, one of which is discussed at more length. Additionally, individual design principles are detailed in the subsequent section. 78

- **Meeting place**: The notion of HUMlab as a meeting place is central to HUMlab as an idea and space, and clearly articulated in early vision documents as well as in actual implementation. This is reflected in the design principles of translucence (encouraging contact and having a sense of what other people are working on), flexibility (supporting many different kinds of meetings and technological platforms) and engagement (a space and endeavor that attracts engagement, intensity and interest), and their spatial and technological implementations. In terms of facilitating a variety of meetings, HUMlab has plenty of social spaces (also outside the lab proper), meeting tables, an "outward" design that make many computer screens visible to others, many large screens, coffee (often free) and a range of software, hardware and activities that attract people from different parts of the university and from the outside. Also, the lab is available to users 24 hours, all year. A well-functioning lab space can help create a platform for managing and supporting research infrastructure in that there will always be a range of competencies and skill sets available, and at best, a willingness to help and share knowledge. The sense of meeting place extends outside the physical lab space, of course, and there is a strong dispersed community, ongoing distributed work and shared data sets, materials and tool development.
- **Multiple modes of engagement**: Another conceptual and epistemic baseline for HUMlab is the interest in multiple modes of engagement with information technology and the digital. This means that the lab has been set up to support work with technology as a tool, an object of study, an exploratory laboratory, an expressive medium and an activist venue. Although there was no early explicit commitment to these particular modes of engagement when HUMlab was started, there was an openness and flexibility (both in terms of technology and 'content') that allowed for very different kinds of projects and activities. Over the years, cumulative practice and reflecting on this practice - also in relation to other international initiatives - has resulted in a model of modes of engagement that could be said to be part of the conceptual cyberinfrastructure of the lab. This commitment to a range of different kinds of engagement has very direct implications for design and infrastructure. For example, a multiple-mode focus is not compatible with having a traditionally instrumental computer lab setup as the space needs to work for activities such as seminars, meetings and relating to various study objects (digital and non-digital). These elements are also important in relation to bringing in researchers and students from the disciplines - not only because familiar elements may be attractive, but also because they perform basic epistemic functions. As we have already noted, a commitment to multiple modes of engagement also calls for a varied technological setup, and HUMlab offers a wide range of technologies for analytical work, visualization, creative work, screenings and physical computing. The downside to this may be that it is more difficult to allocate substantial resources to single areas (as in a specialized lab environment). More generally, it would seem that the humanities often have need for a more diversified and multiplex infrastructure than the kind of science and engineering cyberinfrastructure described in policy and vision documents (cf. the discussion in Part I and the reflections presented in Part III).
- **Context and digital visualization and representation**: A third conceptual foundation draws on the intersection between the humanities as providing rich cultural and historical context and technologies of multiplex digital visualization and representation. Here the primary associated design principle is multiplexity and the most obvious implementation would be the screenscape and underlying technological infrastructure. The screen and interaction

> space has different functions in relation to different projects, activities and modes of engagement. The actual implemented infrastructure clearly stimulates ideas, experiments and uses, and in this sense the infrastructure is just the beginning. Also the prototype design presented in various ways (e.g. a 3D model of the design, a fly through and as a virtual environment) before the space was implemented provoked ideas, but actually having the space makes the process easier, more grounded and multi-level. This exemplifies the iterative nature of the process and the fact that new ideas may develop as a partial result of having cyberinfrastructure.

Humanities Representations and Screenscapes in Practice

In a discussion of the initiative for software studies and associated cultural analytics research at UC San Diego, Lev Manovich points to how having access to the visualization environment HIperSpace at CALIT2 has made new ideas or directions possible: 79

> HIperSpace is the reason why I am able to think of being able to map and analyze global cultural patterns in detail. I would not ever think about it if I just worked on my laptop screen. [Franklin & Rodriguez'G 2008]

While facilities such as HIperSpace and HUMlab are very flexible and will generate ideas, uses and experiments beyond what could be envisioned at the start, it is also true that users and uses are constrained by the way these infrastructures have been thought up and set up. This could be said to be part of the conceptual cyberinfrastructure. HIperSpace is a very large tiled display made up of many small screens - basically a large, rectangular screen with internal mullions (caused by the frames of the individual screens). It is seen as a front end to an optiputer and the main overarching goal is to “examine a ‘future’ in which networking is no longer a bottleneck to local, regional, national and international computing” [Defanti et al. 2009]. The mullions are seen as something that will eventually get reduced and maybe disappear altogether visually - thus creating one large seamless display. HUMlab, on the other hand, has an investment in both allowing for big display walls and for a multitude of separate, visually distinct screens. The frames of the screens are thus quite important, as is the positioning of individual screens in the space. On a very large screen, such as the HIperSpace installation, you are likely to display a number of different materials, sources and windows, and thus the individual bits will be framed on the screen, but this framing is screen internal (cf. the notion of multiplex frames in [Friedburg 2006], and the discussion of computer windows in [Manovich 1995]) and rather different from having separate screens with *heavy* frames. A somewhat related paradigm for visualization is virtual reality (representing an earlier generation of privileged cyberinfrastructure), which often tries to remove the frame altogether. 80

> The visual (and aural and haptic) displays that immerse the user in the virtual world and that block out contradictory sensory impressions from the real world; [Brooks 1999]

In some ways, the distributed screenscape of HUMlab is the opposite of such virtual reality manifestations. In HUMlab, sensory impressions from the “real” world are quite important and the screens are integrated in a lively studio environment. This makes the screens less *aggressive* (to borrow the terminology from [Manovich 1995]) than many other visualization environments. The new part of HUMlab borrows elements from visualization spaces, as well as traditional seminar, studio and exhibition spaces, and the collaborative affordances (whether in relation to technology or not) are quite important. Also, as pointed out above, the screens have their own identity and framing. The epistemological stance is thus radically different from that of many virtual reality environments where you, as Dan Sandin, co-inventor of the CAVE, points out, “in a sense, view things from inside the scene” [Russett 2009, 183]. In other words, there is arguably no frame. 81

> There would be no screen between the user and the information and no way for the user to step back and contemplate the screen at a distance, because she would be wearing the screens as eyepieces that completely covered her field of view. [Bolter and Gromala 2003, 54]

HUMlab attempts to bring together multiplex frames (digital screens that contain separate elements such as windows) and multiple digital screens in a held-together screenscape. Each screen can be run individually in the screenscape, be part of a large 'computer desktop' or be part of a video-signal level desktop or extended space (which can include video, computer and other sources). The screenscape as a whole is part of a large studio space with a seminar table in the middle of the room. In this way a range of practices and possible uses can be supported, spanning from traditional seminars (with no or little technology used), to individual researchers using their workstations with one or several screens, to research groups using the large high-resolution touch screen collaboratively and in a distributed fashion with remote data sets and researchers, to student use of three screens to discuss different solutions to an assigned problem, and even to large interactive art installations that use screens, different kinds of sensor technology and spatial audio. 82

Let us look at a few examples more directly in relation to various humanities based uses of the kind of environment that is described above (excluding uses that do not use any or little technology). As digitalized material becomes increasingly available, a screenscape can help philologists and art historians to display and interact with a number of manuscript pages or pictures. Researchers in environmental archeology can pull together large data sets, diverse materials and visualized data models in one space, and use a large, high-resolution screen to work with the data model (zooming, modifying, interrelating the model with data sources) locally or together with remote research centers. Site-specific art installations can be created in the space. Students who have built virtual exhibitions in Second Life can show their individual or their group's slices of their virtual world on screens. Events such as an indie game evenings can make use of all the screens to allow people to interact with a range of games, and in an associated presentation, individual games can be moved to the large screen and juxtaposed as part of a comparative and analytical process. Other events may bring in remote researchers through different types of virtual environments and through visualized data sets. Thematic screenings of films can be facilitated in the space. An upcoming seminar with an international guest speaker can be contextualized through a curated selection of images, video clips, texts and web pages. More generally and visionarily, complex scholarly environments for humanistic research can bring together analytical tools, distributed materials, representations and ways to tackle central research challenges in a studio space such as in the aforementioned descriptions, as well as in associated online spaces. 83

There is certainly an interesting interrelation between the humanities and technology supported visualization and representation, and hopefully the above description shows that associated cyberinfrastructure comes with certain epistemic commitments, but also that uses grow from the actual implementation and experimentation. Looking at the conceptual cyberinfrastructure associated with new part of HUMlab, we have seen that multiplexity and framing are critical factors. HUMlab is different from virtual reality manifestations where there is ideally no frame (once you are "inside") and from installations such as the HIperWall which are basically very large multiplex frames. [Friedburg 2006] suggests a taxonomy of variables mainly based on a cinematic perspective, which includes multiple screens, but her examples are limited to cinematic representation (such as Charles and Ray Eames' Glimpses of the USA exhibition at the 1959 Moscow World's Fair). In her discussion of computer screens, Friedberg seems to suggest a one-screen (multiplex frame) paradigm: 84

> The Windows interface is a postcinematic visual system, but the viewer-turned-user remains in front of (vorstellen) a perpendicular frame. [Friedburg 2006, 232]

This view is challenged by the increased use of many linked but individual screens (available on MACs from the late 1980s and on Windows since the mid-nineties). Interestingly, [Colomina 2001] shows in her analysis of the Eameses' multimedia architecture how separate video screens, although not one screenscape in a technical sense, can create a thematic and performative whole. With seven enormous screens and seven individual images per screen and one final image, there were a total of 50 images in *Glimpses of the USA*. These images were presented in thematic bursts in a highly coordinated and very carefully planned installation. Although this arrangement does not make the individual frames visually multiplex at any given time, frame-internal multiplexity is achieved temporally. 85

The HUMlab setup explores the importance of having multiple screens and multiplex frames at the same time and how this relates to the essence of the Humanities - rich cultural and historical context, heterogeneous qualitative and quantitative materials, different modes of representation and presentation, shared presence and multiplex perspectives. 86

Design Principles

Design principles provide a layer in between the layer of conceptual cyberinfrastructure just discussed and the actual implementation. In the case of HUMlab, a number of central design principles have emerged in the course of the development of the lab. While these principles naturally are situated in a specific context, they also have some more general applicability. 87

Design principles can be seen as a way of connecting the ideational level with material cyberinfrastructure, and as facilitating a means of discussing and articulating infrastructural projects without getting caught up only in detailed infrastructure and/or the abstract visions typical of the discourse on cyberinfrastructure (cf. Part I). The principles are seen as being anchored in both these levels. In the following, I will discuss a number of suggested design principles for HUMlab as an infrastructural project. The seven principles in question are translucence, flexibility, memory and context, multiplexity, non-linearity and messiness, engagement, and adaptability and co-evolution. While these are not all-inclusive or unchanging, they suggest an anchored and systemic-level foundation for HUMlab as infrastructure. 88

In designing the space of HUMlab, an important design principle has been *translucence*. The basic idea is that it is important to 89 see what is going on in the lab while not resorting to having one large and totally open space. In optics, translucent materials allow light to pass through them diffusely. The constraints and affordances are not only visual, of course, and awareness of whether other people can hear you or not is, for instance, an important factor. In a studio (or other) environment, this translates to having a space which has divisions and separation which allow for sub spaces to maintain spatial, auditory and conceptual integrity (to different degrees), while also retaining a sense of what is going on in other parts of the space. This affects possible interactions in several ways (cf. [Erickson & Kellogg 2000]). On one level, you have access to concurrent activities, processes and dialogues. For instance, when the lab or a project is presented to a delegation in the inner glass room, there is a good visual sense of activities and people outside the room. Similarly, people outside this room have a sense of what goes on inside (and will for instance be prepared to act when the delegation prepares to leave the inner room). Dourish and Bly's notion of awareness and their porthole system are based on a similar notion, although they emphasize the distributed nature of the system:

> Awareness involves knowing who is "around," what activities are occurring, who is talking with whom; it provides a view of one another in the daily work environments. Awareness may lead to informal interactions, spontaneous connections, and the development of shared cultures — all important aspects of maintaining working relationships which are denied to groups distributed across multiple sites. [Dourish & Bly 1992., 541]

HUMlab takes as its point of departure the organization of collaborations across physical-digital boundaries. For instance, seminars primarily take place in the physical space, but they are almost always streamed live, and sometimes there is a secondary screen showing remote participants interested in participating in the discussion. Earlier this was done through a text-based chat client, and later with video based software. The list of remote participants on the screen (which is visible to the physical participants) can support a sense of shared presence and increased awareness. Similarly, a tweet visualization with local and distant tweets in relation to an ongoing seminar helps create a back channel with shared awareness. An important point in relation to Dourish and Bly's article is that designing for awareness and translucence is quite important also in physical space, and that many current spaces are *mixed.* 90

In the physical lab, screens (both public and semi-private ones) play an important role in representing ongoing work and in bringing in external worlds and materials (portholes). Activities can thus go on in both sub spaces and still retain a sense of co-presence and co-location without unnecessarily disturbing each other. Moreover, this arrangement opens up space more generally and helps coordinate collaboration. In the open part of HUMlab, translucence is supported through many separate, semi-private sections as well as through the way screens are positioned to allow a sense of ongoing work. The translucent nature of dividers (e.g. half-tall bookcases, hanging absorbents, pillars and screens, and an aquarium) allows dialogue, co-presence and some over-hearing between sections. 91

Another relevant parameter is *flexibility*. A wider range of activities and initiatives can be supported through allowing flexible use of an infrastructural resource such as HUMlab. The importance of flexibility is often emphasized in work on design of learning and studio environments ([Merkel 1999], [Jamieson et al. 2000], and [Gonsalvez & Atchison 2000]). Simple examples would include ease of reconfiguring the space and changing furniture around, allowing many different kinds of activities, flexible distribution of media, and a multiplex technical implementation. It could be argued that a flexible setup allows more change in pedagogical, scholarly and technological practices, whereas a fixed setup has a stronger investment in a particular model or framework (cf. [Mitchell 2003]). There is a tension, however, between what is flexible and what is fixed, and total flexibility is probably not realizable as there will always be decisions that constrain the level of flexibility. A totally flexible space would probably have to be a compromise. Also, some degree of fixedness can be part of good design practice and deliberate choices to encourage certain kinds of use and activities. In the case of HUMlab, and probably many other similar environments, there is a rather delicate balance between flexibility and fixedness. Some of the fixedness comes from a set of basic underlying ideas about what a space is and how it should be used and can be seen as part of the conceptual cyberinfrastructure. In some of the virtual spaces associated with HUMlab, similar tension can be observed. For instance when an art installation and artist (with assumptions of exhibition and controlled space) co-exist in the same Second Life space as people who are continuously doing experimental building, and who fly through the asserted space of the exhibition with e.g. space ships. Negotiation is often needed in order to resolve these clashes. 92

One of the things which distinguishes a studio space from a meeting room or most classrooms is that there is a strong sense of ongoing work and activities. There is a richness to such spaces which partly comes from the *memory and context* interwoven into the various modes of expression present and in traces from previous projects and people. In a design studio you will often 93 find sketches and prototypes, which provide a sense of process and provide points of display and discussion. As a set of disciplines, the Humanities are much concerned with rich historical and cultural context, which would seem to be well in line with a highly contextual space. If this space is also flexible, it may allow for shifting contextual landscapes (e.g. through dynamic screens, cf. [Manovich 1995]), as well as a more static or semi-static memory and context.

Multiplexity is a parameter that interrelates with translucence, flexibility and rich context. If complex processes and themes are important to the humanities as well as collaborative, trans-disciplinary projects, it is relevant to have a cyberinfrastructure that supports these multiple perspectives, complex data sets and heterogeneous context. In HUMlab, multiplexity in this sense is facilitated in particular through the screenscape in the new part of the lab. It allows the simultaneous engagement with many types of materials, ideas and perspectives through the screens, interaction technology, sensor technology and audio. Furthermore, many screens ideally have an empowering function in that there is not only one main screen, which is typically controlled by a teacher. Being in control of a single screen is often the same thing as having the floor. The screenscape in HUmlab can be controlled by one user, all the screens can be used together, or single users can use one or more screens individually. In HUMlab, multiplexity is also supported through the many different kinds of meeting and work places in the total studio space and through digitally supported spaces. In addition, the technology setup is multiplex in that it includes a variety of technologies, systems and software. It is quite common that students give this varied setup as an important reason for working and studying in HUMlab. Most technology rich labs at the university are either generic (basically providing browsing, word processing and printing) or program or department specific (often being highly specific and restricted as e.g. 3D modelling labs at the computer science department). One underlying idea in HUMlab is that a varied technological setup can afford exploration and many different types of activities and cross-over effects. 94

Non-linearity and *messiness* is about the importance of having spaces that are not too linear, orderly or sterile. Spaces such as university classrooms do not normally reflect ongoing work and tend to be fairly non-descript and standard. When the class is over, the norm is typically and understandably that the room should be left tidy and organized (and hence fairly devoid of rich context). Studio spaces, on the other hand, typically reflect ongoing processes and are hence more contextual and untidy. 95

> While each and every piece of among the multitude of material objects that appear in a progressive design studio seldom by itself has a strong or even explicit link to an aspect of the project at hand, they as a collection seem to conspire to create the rich environment needed to stimulate creativity and create novel ideas. [Fällman 2007, 5]

In his discussion of artistic studio spaces, [Buren 2010, 160] emphasizes how the collection of visible materials viewed at the same time creates a sense and understanding of process. 96

While lab spaces typically allow more exclusive use of the space than regular classrooms they tend not to be as obviously untidy and processual as studio spaces. Indeed, [Lehmann 2009] points to connotations of secrecy and specialized technological processes associated with laboratories and how media labs may maintain some of this sense of *black box.* There is certainly an element of exclusiveness associated with many lab environments, however, it would seem that Lehman underplays the difference between *laboratory* and *lab* (and *media lab*). In any case, many lab spaces, not least new ones, appear somewhat sterile - in particular if they are large, rectangular and fairly mono-functional. Traditional spaces are also often horizontal in the sense that floors and ceilings are rarely used beyond their obvious core functions – they are not seen as important design elements in a non-linear space. 97

An important but somewhat illusive parameter is the sense of personal investment, energy and attractiveness that may be associated with a space and its people, activities and direction. Some spaces seem to lend themselves to *engagement*, which may be manifested in that the space is “a place to hang out,” through its sense of *energy* and that visitors can engage directly with the space and remember it afterwards. [Mitchell 2003] talks about the intensity of a space, and it might be argued that a high-intensity space encourages engagement, collaboration and exploration. It is, of course, impossible to pinpoint exactly what gives a space such qualities, but it would seem that non-sterile and heterogeneous spaces are more likely to evoke this kind of sentiment, and that a sense of energy can be derived from many (different) people sharing the same space, from ongoing creative work, from a sense of process and from a culture that supports collaboration, community and dialogue. The flow of people gathering for different activities, project meetings and their own work is quite important in this context, and the constant influx of new people such as visiting postdoctoral fellows and guest speakers adds to that energy as well as integration of external materials and distributed presence. Physical elements can clearly play an important role here, and examples from HUMlab include the neon sign outside the lab, beanbags, inviting couches and tables for meetings and coffee drinking, pictorial mats, designer wallpaper, nice-looking whiteboards, plants and a large aquarium. These elements can be as critical as 98 computer workstations in supporting a collaborative, engaging technology-rich environment, but their meaningfulness is also contextual and situational. Thrown-in beanbags and designer couches will not automatically produce an attractive studio space.

Regardless of the time and money invested into planning and designing a learning or lab space, and regardless of the amount 99
of flexibility built into the space, a space cannot be said to be finished when it has been installed. Beyond any extended installation phase or regular long-term maintenance plan, there is a need to think about space as a dynamic and evolving entity that is intrinsically linked to users and inhabitants of that space as well as any underlying ideational grounding. Actual use of a planned space can be predicted and simulated, but use of space is contextual, social and, at least sometimes, unpredictable. It may be possible to make a distinction between flexibility (basic *designed* flexibility), adaptability (fairly quick responses to apparent needs and usage patterns) and co-evolution (long-term changes as a consequence of the interplay between the space, users of the space and the conceptual cyberinfrastructure). The more long-term processes are thus *adaptability* and *co-evolution*. In a longer perspective, the life of a building and a site, also these processes are fairly short term. Brand distinguishes between different layers of shearing from site (eternal) to structure, skin, services and space plan to stuff [Brand 1995, 12–13]. Most of the processes mentioned here would be related to space plan and stuff (furniture, appliances etc.), and sometimes services (communications wiring, electrical wiring etc.).

As indicated above, a basic presumption is that in most cases, it is not possible to create a totally flexible space, and that there 100
is a tension between a very high degree of flexibility and a grounded, context-specific ideational basis. In HUMlab, an example of flexibility (“stuff”) would be moveable chairs, light-weight tables, portable screens and distributed control of audio systems. An example of adaptability (*space plan* and to some extent, *services*) may be when a table intended for other use increasingly started to be used by laptop users and was hence equipped with cabling and new light fixtures, or when an underused part of the lab was redesigned with lower bookcases (to allow a higher degree of contact through translucence), a new laptop-friendly table and a new combined whiteboard and projection screen (see Figure 3).

Figure 3. Photo of HUMlab (redesigned corner)

After the corner space was redesigned into this more “café-like” setting, usage increased significantly. Given that a space 101
develops over many years, there will be on-going co-evolution between the people and activities of that space and how the space is continuously reconfigured.

Part III: Strategizing and Implementing Humanities Cyberinfrastructure

Introduction

As we have seen in this article, research infrastructure for the humanities is diverse, multi-level and often distinctly material and highly abstract at the same time. With an inclusive definition of research infrastructure, almost anything needed to carry out research in the humanities could be included: ranging from paper, pens, books, furniture and people to database structures, grid computing facilities, visualization centers and libraries. We saw in Part I how cyberinfrastructure can be seen as a science and engineering project associated with funding mechanisms, policy making and high-cost research equipment of national or international interest. In Part II, a specific humanities infrastructure was presented and analyzed, and related to design principles and an ideational level, called conceptual cyberinfrastructure. 102

If we regard cyberinfrastructure as a system, it could be argued that the humanities needs to look at its own existing and future infrastructure in systemic terms. Through arguing for a diversified but conceptually unified infrastructure, it may be possible to both match the epistemic scope of the humanities and incorporate elements that would be difficult to incorporate if the focus is on isolated pieces of equipment. For instance, if we see a centrally located seminar table as important to a planned instance of humanities infrastructure[1], it should be part of our conceptual framing and implementation. A diversified, but amalgated, infrastructure is also in line with a broad notion of infrastructure suggested by the 'infrastructure turn'. Part II provided an example of how a specific humanities infrastructure can be packaged and unpackaged in this way. We will now look more closely at some aspects of packaging and implementing humanities cyberinfrastructure. 103

Some General Reflections

In this article, it has been argued that it is vital that the humanities engage in conversations about research infrastructure and articulation of possible infrastructural needs. It seems reasonable to see the *infrastructure turn* as an important possibility for the humanities, but one laden with assumptions, political context and some risks. For instance, we need to be careful not to uncritically buy into a science and engineering paradigm or only using existing infrastructure, such as libraries, as a default model for new infrastructure. Articulating a humanities-based notion of cyberinfrastructure requires reflection and careful consideration, but also strategic action and interest in implementation. However, we also need to learn from each other and from disciplines and areas that have a strong infrastructural tradition [Rockwell 2010]. 104

It would seem sensible to let the process from idea to actual implementation take time given the often high cost of research infrastructure and the relative lack of established infrastructural framing for the humanities. Rockwell argues that we should support research infrastructure experiments [Rockwell 2010]. Indeed, conceptual sketches, digital models, simulations and different kinds of prototyping are important tools in considering, testing, and evaluating suggested infrastructures. Mockups, structural diagrams and user trials can help thinking through a digital database tool, and a small-size lab installation can generate important knowledge for a planned large-scale installation. Moreover, a digital humanities laboratory or center can be seen as an experimental space or playground in itself. In the case of HUMlab, this has been manifested through having a wide variety of technologies and competencies available in the lab, and encouraging exploration and experimentation. 105

One common assumption, sometimes even a defining criterion, evident in the discourse on cyberinfrastructure is that research infrastructure is distributed. Not just in the sense of data or tools being located elsewhere, but in the sense of a shared vision of a distributed research space. When discussing virtual organizations, Cummings et al. say that through coordinated infrastructure, "scientists and engineers can work together in environments that allow scientific integration, greater access, efficient problem solving, and competitive advantage" [Cummings et al. 2008, 3]. (The main title for their report is illustratively "Beyond Being There.") Atkins et al. talk about distributed "laboratories without walls" as a major emergent development [Atkins et al. 2003, 13]. Typically, work and data are not seen as simply distributed, but are said to require high capacity networks and distributed computing power. While most digital humanities infrastructures are distributed in one sense or another, it might be argued that physical space and local context can be quite important infrastructural components, and that we do not necessarily need to buy into a "placeless," high-capacity and all-distributed sense of infrastructure. It could be claimed that the digital humanities operate across a spectrum of distributedness. Twitter, Zotero, Flickr and Second Life are all examples of distributed platforms that could be integrated in many digital humanities contexts as well as complex database systems, online tools, live shared visualizations and grid computing. While all of these elements can potentially be integrated in a physical lab or studio space, many will not. 106

As we have noted, a related assumption is that technology included in cyberinfrastructure needs to be high-capacity, top-of-the-line and advanced. Grid computing is much more likely to be incorporated in this kind of discourse than, say, Zotero and non-massive datasets. The NSF Blue-ribbon report on cyberinfrastructure [Atkins et al. 2003] contains 55 instances of the word "advanced" and 21 instances of the collocation "advanced cyberinfrastructure." It is pointed out that "[b]y advanced we mean 107 both the highest-performing technology and its use in the most leading-edge research” [Atkins et al. 2003, 5] (original emphasis). This is an example of how certain expectations in fact define what is and what is not research infrastructure. While a platform such as Twitter may not match these expectations, it is worth carefully considering Matthew Kirschenbaum’s question: “Q: Has Twitter done more as DH cyberinfrastructure than any dedicated effort to date?” [Kirschenbaum 2010]. The templates of cyberinfrastructure, however, can be tweaked and reframed if necessary. For example, through advocating for a varied and multiplex research infrastructure for the humanities, it may be possible to gain enough leverage for it to qualify as cyberinfrastructure, while not sacrificing many of the technologies and uses that may not qualify as research infrastructure by themselves.

We will now briefly look at some issues that have been quite important to establishing HUMlab as infrastructure, which have more general applicability: the framing of cyberinfrastructure, the importance of owning the port, the humanities pushing the technological envelope and why we need to speak up. 108

Framing Humanities Cyberinfrastructure

Funding is a central concern for most infrastructural projects. Here the humanities often find themselves in a position where sources of funding are mainly adapted to other areas. At one point, HUMlab attempted to apply for research infrastructure funding of a fairly traditional science and engineering kind although this focus was never made fully explicit. One problem in this application was matching the funding agency’s expectations of infrastructure with the planned implementation. For instance, the call in question made it clear that applications should be for functional units and that these units are normally quite costly (this category of funding was for expensive equipment). The type of infrastructure envisioned had some high-cost parts, but was much more diverse and distributed than what was clearly expected in this context – anchored in the idea of a fairly broadly conceived humanities and technology lab. The prototypical candidate for this kind of call was probably an expensive microscope, spectrometer or high performance computing unit; all functional and physical units of considerable cost. The application was not successful, but it was a useful exercise in that it made it clear to us that we needed to frame the cyberinfrastructure of the lab – not necessarily to conform with the expectations of the funding agencies, but rather to make a convincing argument for a different type of infrastructural need based on a different epistemic scope. The framing that developed from this process emphasized multiplexity (the need for many different kinds of perspectives, technology and infrastructure), local and distributed collaboration (partly through shared presence and materials), experimentation (the need to try infrastructure out together with humanists), openness (the infrastructure would attract humanities researchers but also many others) and a high degree of access to the infrastructure (24 hours all year). 109

Owning the Port

There were some important decisions made at an early stage that shaped HUMlab’s basic infrastructure and that were also partly a result of good relations with the university-wide computer central. For instance, at the point at which HUMlab was started the most logical choice would probably have been to make the network proxy-based like in most of the student laboratories. However, this would have made the lab network more closed and it would have been difficult to make use of some software requiring specific network ports to be open (such as some virtual world software and some systems for streaming media). The fact that HUMlab was given the kind of network connection used in faculty and staff offices was important and allowed experimentation that would not have been possible, or at least difficult, otherwise. This particular issue would probably not be very relevant in relation to present-day installations, but there are many other choices and considerations that may similarly create obstacles or possibilities (some of which are so-called “last mile” problems). Some of them may seem like purely technical low-level considerations without any obvious *content* repercussions, but if possible, it is important to be involved in such decisions, and have people on board with a good sense of technical infrastructure as well as with an engagement in the humanities and the interface between the humanities and technology. 110

Another low-level technology example concerns a rather inconspicuous metallic box mounted on one of the HUMlab walls. The box contains six pairs of optical fiber connected to the university computer central and the virtual reality lab. Without good support from the central university administration this installation would not have happened, and one general experience is that it is important to get as much done as possible at the point of installation. The box has never actually been used, although there were some fairly feeble attempts to connect HUMlab to the virtual reality laboratory at one point. Thus, this is clearly a failed investment on one level. The original rationale was for connecting high-level visualization facilities, and for future (largely undefined) use. Even though the connection has not been used in the 10 years since it was installed, it might be argued that it has provided high-level bandwidth and connective possibilities (although unrealized). Of course this non-use is not optimal, but 111 it can also be seen as part of providing a good base level infrastructure. There is also often a window of opportunity when initial investments and construction work are being done. Certain installations can often be done fairly easily done as part of a larger construction project. And when looking at future expansion plans and creating portals between HUMlab and HUMlab-X, and between HUMlab and several international digital humanities centers there has indeed been renewed interest in the dedicated optical fiber connection.

Conceptual Cyberinfrastructure and Humanities-based Technological Innovation

Most digital humanities cyberinfrastructures are likely to incorporate technology to at least some, but often considerable, extent, and going from idea and concept to actual implementation is not always a simple or fast process. If all it takes is a number of standard workstations, or a standard database server, there will most likely not be a problem, but larger and non-standard installations are often complex. This is true generally speaking, and it is important to have a clear vision and to be able to communicate with technology experts in a dialogic and informed fashion. In the case of humanities infrastructures, which may be built on different epistemics, there may be problems that stem from the differentness of the envisioned installation. In such situations, it is quite important to be knowledgeable and communicative enough to be able to work the planning and implementation processes. 112

Returning to the screenscape in HUMlab, this installation did not fit the template in several ways. For instance, the standard multiple screen scenario combines screens to create larger, seamless displays. Having screens spread out at the periphery of a large space is less common. Several participants in the design process argued in favor of one large screenscape which connected the screens seamlessly (rather than having them separate). Installing the 11 large screens was not a major technical problem, however, rather the complexity lay with how they are controlled and made accessible. Also, the screenscape included a 4K projector with very high resolution, which added an additional layer of complexity. The basic idea of rich contextualization, humanities-based representation and flexibility was implemented through a complex system where the total screenscape can be run through dedicated computers (one computer per screen), from one computer with an 11-screen desktop or through a video signal level system (where 24 sources irrespective of type can be placed in the screenscape). This is obviously not an off-the-shelf system, and it is critical to be able to not lose track of epistemic grounding and the basic idea while discussing implementation with researchers, experts and others, and when carrying out the implementation. HUMlab’s screenscape is an example of a humanities infrastructural installation pushing the technical boundaries - and this is a recurring experience. When the head of one of the computer functions at the university described HUMlab at one point he said that it is the most interesting technology space on campus. The point here is that it is quite possible for the humanities to create a functional and highly visible platform, and that epistemic commitments of the humanities disciplines can make for interesting technological challenges that will often attract students and experts from the fields of technology and engineering. 113

Speaking Up

Implementing large, and also often smaller, infrastructural projects in a university context is typically a fairly complicated processes with many people, competencies, sub-processes and different levels of decision and policy making involved. The degree of control and expected involvement depends on many different factors, but in any case, anyone involved in this kind of process as a main agent will have to take part in any number of meetings, negotiations and concerns about low-level technical and constructional details. Speaking up is important. Here design principles can be useful as a kind of intermediate language and, in the case of HUMlab, working with a 3D model of the planned new part of the lab turned out to be very useful. Partly because the model allowed the exploration of different possibilities, but also because the "finished" model served very well when planning the actual implementation with international experts, contractors, the property owner and university administration. 114

Figure 4. Rendering of HUMlab from 2006 (based on a 3D model)

In Figure 4, the right hand side of the visualization represents the existing part of the lab (as of the beginning of 2006) and left hand side represents the planned addition. The end result did not turn out quite as planned, but the basic conceptual grounding and the layout are very clear in the actual implementation. Apart from still visualizations, associated animations were also created, and these proved quite useful in general presentations of HUMlab and when discussing the project with funding agencies. 115

As has been noted, seemingly small decisions can have significant impact. It is often useful to follow the implementation process quite closely and to talk to the people involved in the actual implementation (construction workers, engineer, programmers etc.) continuously. This allows you to ensure everyone has a sense of what the installation is about, learn from each other, and react if there are any misunderstandings. Sometimes there might be very different views on the impact of certain decisions. On one occasion in the planning of the new part of HUMlab, there was a meeting with most of the contractors, university administration and the property owner, where one point of disagreement was the new cooling and ventilation system for both parts of the lab. As mentioned previously, upgrades of existing infrastructure are often easier when you are doing new installations. 116

The plan that had been decided on included partially lowering the ceiling in the old part of the lab. Even if this may seem like a fairly significant change, it had not been communicated verbally, and even if HUMlab had had access to the relevant drawings, they would have been difficult to decipher for laymen. The point here is that to the contractors this was not a major change. They needed to fit large pipes above the ceiling and the most reasonable way to do this would be to lower the ceiling – a matter of implementation. At this point, only the HUMlab representative (among 15 people) spoke up and articulated the importance of the varying ceiling heights of the lab, and how it would be very unfortunate to implement this change. The argument was not functional in a strict sense but rather aesthetic and about the energy and sense of the space. Through support from the university administration the contractors were asked to see if there were any alternative solutions (although it had been said earlier that there was only that one possibility). When the rationale had been communicated the contractors found an alternative solution, and eventually a way was found to keep the ceiling intact. Also, the intricacies of the ceiling scape (above the visible ceiling) became much clearer to the HUMlab representative. 117

Another interesting point of negotiation concerned wallpapering four pillars with a green, leafy pattern in order to help create a 118 sense of a room without the walls, where the proposal (partly a result of working with interior decorators) was deemed impossible or not suitable no less than three times. This may partly have been a gendered experience as the two interior decorators were women proposing an atypical use of wallpaper to a totally male dominated work and management group. The issue was resolved after HUMlab made it quite clear that the wallpaper was very important to the whole expansion. It turned out that one rationale for the initial unwillingness to wallpaper the pillars (for the workers) was that it would not be possible to do high-quality wallpapering on the round but multi-faceted pillars. Afterwards, everyone involved agreed on the success of the wallpapered pillars as concept and implementation. A general finding here is that intense collaboration and talking are critical, and that there is real value to clearly articulating what we, as part of the core operation of the university (research and teaching), need in order to carry out or work.

Conclusion

Speaking up must be done on many levels. At a workshop on humanities cyberinfrastructure at UC Irvine in 2006, there was an appeal (or maybe request) from Dan Atkins, then head of the NSF Office of Cyberinfrastructure, that the humanities and social sciences step up and show leadership in relation to the issue of future cyberinfrastructure. This article can partly be seen as a response to this request in the sense of suggesting a model grounded in core humanities challenges, the conceptual cyberinfrastructure to tackle those challenges (if any), as well as in design principles and as exemplified in implemented cyberinfrastructure. We need to reflect critically on cyberinfrastructure, explore ideational and technological visions, and think about the future of the humanities. The call is arguably ours. 119

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Notes

[1] We have mentioned three examples where such a table evidently plays an important role: ACTlab at the University of Texas [Svensson 2010], Humanities Computing at University of Alberta [Svensson 2010], and HUMlab (this article).

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