



Universiteit
Leiden
The Netherlands

Reflexive inertia : reinventing scholarship through digital practices

Kaltenbrunner, W.

Citation

Kaltenbrunner, W. (2015, May 27). *Reflexive inertia : reinventing scholarship through digital practices*. Retrieved from <https://hdl.handle.net/1887/33061>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/33061>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/33061> holds various files of this Leiden University dissertation

Author: Kaltenbrunner, Wolfgang

Title: Reflexive inertia : reinventing scholarship through digital practices

Issue Date: 2015-05-27

Conclusion

The topic of this thesis, broadly conceived, has been the question as to how the development and use of digital research instruments is related to changes in the organization and conduct of scholarly inquiry. Although computational methods in the humanities have a long history, it is only recently that they have attracted attention beyond their traditional user communities. Digital humanities, the presently common shorthand for such approaches, is serving as a prism through which various actors – digital and traditional scholars, policy makers, as well as the media – imagine the future of the humanities at large. Practitioners are also heavily involved in current initiatives to build digital infrastructure, an undertaking that mobilizes significant amounts of funding, and one that has potentially long-term effects on future research practices. In the first part of this concluding chapter, I will summarize my conceptual framework and empirical findings, according to the order of my five original research questions. In a second part, I will draw conclusions that further develop my conceptual framework, as well as discussing some practical implications. Finally, on the basis of this, I will suggest directions for future research.

In analyzing my empirical material, I have drawn on three conceptual resources: infrastructure studies (Star & Ruhleder, 1996; Bowker & Star, 2000; Edwards, 2010), theoretical literature on disciplinary conventions that emerge from the packaging of material and semiotic relations (Fujimura, 1987; 1992; Law, 2004), and comparative research on the social and intellectual organization of different fields (Whitley, 2000; Becher & Trowler, 2001). At first sight a heterogeneous set, these approaches can actually be used in a mutually complementary way to highlight a range of challenges that accompany the move to digital scholarship. My principal conceptual assumption is that scholarly knowledge is generated within an infrastructure. Drawing on Star & Ruhleder (1996) I define the latter relationally, rather than substantively: infrastructure is not a specific thing, but obtains when interrelated practices fall into a workable configuration. Embedded in this ecology of practices, and co-evolving with it, are material tools, protocols, and standards, for example regarding data and publication formats. These elements are bound up with the conceptual and social structure of scholarly fields. Established data formats for example constrain possible modes of theorizing, and the peer review protocol serves to validate new contributions to the body of scholarly knowledge. Practices moreover are reproduced through institutional mechanisms. Students learn how to

develop scholarly arguments, write books, and use bibliographies to conduct literature searches in their undergraduate classes, and specialized degree programs teach librarians how to organize and curate information in ways that connect meaningfully to scholarly practice. Functioning infrastructure thereby constantly performs what it means to engage in 'proper' scholarship, so that only particular ways of working, particular knowledge claims, and particular forms of scholarly output are recognized as adequate.

Intersecting this perspective with my other two conceptual resources has allowed me to theorize in more detail different aspects of the scholarly infrastructure. The work of Whitley (2000) is useful for highlighting its disciplinary specificities. When compared to most natural sciences, scholarly fields such as history, philosophy, and literary studies are characterized by a relatively weak degree of social and intellectual integration. There is a characteristic plurality of theoretical approaches, which coexist and fuel each other through the conceptual contradictions they create. The dominant format of circulating knowledge products is the monograph, which gives individual writers considerable intellectual and stylistic freedom. Highly integrated fields, by contrast, such as the various sub-disciplines of physics, are characterized by strong agreement on shared theoretical foundations and pressing research problems, and by a tightly coordinated work process that is frequently organized around the use of expensive, large-scale instrumentation. Most natural sciences generate a type of knowledge that is quickly superseded by more recent findings, while scholarly knowledge can retain its relevance to disciplinary audiences for a potentially much longer time. The concept of hinterlands by Law (2004) can be used to theorize in more detail those aspects of an infrastructure that actors draw on and reproduce when they generate new knowledge contributions, i.e. its methodological and epistemic foundations. Law conceptualizes method not as an objective, context-independent protocol that allows to extract hidden meaning out of social realities, but rather as a generative device that selectively amplifies aspects of a research object according to particular epistemic conventions. This emphasizes on the one hand the disciplinary criteria that individual knowledge contributions must resonate with to be considered adequate. It also draws attention to the fact that some contributions are easier to generate than others because they mobilize gradually standardized sequences of articulation work. Articulation work denotes the situated effort necessary to align principally disparate material and semiotic elements in the process of developing an argument (Fujimura,

1987; 1992). It includes for example the collection and curation of snippets of empirical material, but also presenting and defending research at conferences or in negotiations with anonymous journal referees. The practical conduct of articulation work is facilitated if one sticks to established routines – established data formats for example suggest particular ways of ordering and analyzing empirical material, and adherence to methodological conventions reduces the complexity involved in negotiating the closure of particular research problems. In their totality, these packaged routines constitute what Law calls the hinterland of a discipline.

As a guiding metaphor, I have used the image of scholarly infrastructure as a knowledge-producing machine. The metaphor is not meant to suggest a singular monolithic entity, but rather to highlight the historical interconnectedness and complexity of its internal mechanics. Taking inspiration from Edwards et al.'s (2011) complementary image of communication as a lubricant that facilitates data-sharing across geographical and disciplinary distances, I suggest that the machine functions smoothly only when its many moving parts are properly configured and compatible with each other – i.e., evolving, but shared epistemic frameworks, a workable division of labor between different practices, as well as standards and protocols that complement established routines. Digital scholarship, however, presents more or less substantial challenges to this infrastructural balance. It entails new possibilities for collecting and analyzing material, new ways of raising and defending knowledge claims, and uncommon requirements regarding the organization of the research process. If scholarship can be thought of as a complex knowledge-generating machine, the move to digital scholarship constitutes an attempt to swap some of its parts while the machine is running.

Summary of empirical findings

My first research question has been geared to investigate the implications of this view for the mutual shaping of digital research technology and current scholarly practices. *What does it mean to think of scholarship as an inert infrastructure, I have asked, and how does this inertia shape the embedding of new research tools in scholarly practice?* In the first exploratory chapter I have investigated the controversial digitization of the bibliography of Dutch Studies (BNTL). Edited for many years by the Huygens Institute of the Royal Netherlands Academy of Arts and Sciences, the use of the BNTL has

traditionally been part of the curriculum of Dutch Studies and thoroughly part of disciplinary practices. Scholars use the bibliography to find sources and delineate a body of relevant scholarly knowledge. In several ways, the bibliographical perspective informs the conceptual deep structure of literary scholarship, for example by continuously performing categories such as 'author' and 'oeuvre'. The BNTL thus can be considered to be part of the infrastructure for scholars in Dutch Studies. The digitization transformed the bibliography from a physical book to be consulted in libraries into an online database. An important change was the managerial decision to save cost by downsizing the editorial team. As a result, the bibliography now covers a smaller number of publications overall – predominantly well-known journals in literary studies and linguistics, but fewer monographs and edited volumes. On the other hand, users now have the possibility to add publications themselves, in case they are not automatically covered. The designers of the digitization plan moreover emphasized the benefits of immediate, automatic updating of the dataset, as well as the possibility to inspect abstracts and full-texts of individual article entries. My empirical investigation revealed that specific ways of asking questions and organizing empirical work had a strong influence on how the digitization was perceived by BNTL users. In the areas of textual criticism and analytical bibliography for example, the more comprehensive, editorially warranted coverage of the old BNTL was an important epistemic precondition. Rather than an overall 'improvement' of the bibliography as suggested by the designers, the digitization constituted a rather significant infrastructural disruption for these research practices.

Such tensions, one might argue, are characteristic of contexts where science administrators and policy makers take important design choices in a top-down fashion. However, my analysis of the COST Action Women Writers in History (Chapter 2), in which technological design is thoroughly grounded in the research interests of scholars, has highlighted problems of a similar nature. The participants had built a career around studying the activities of women writers between the 16th and late 19th centuries, thus complementing more traditional historical accounts that focus on a limited number of heroic male figures. The collaborative use of an online database seemed like a great opportunity to align individual research efforts and so create a more comprehensive empirical picture of 'forgotten' literary history. In spite of similar disciplinary backgrounds and a shared interest in digital technology, the participating scholars encountered significant difficulty when trying to embed the database into their monograph-oriented work

routines. It firstly required integration of very diverse research questions and methods, as well as bringing diverging theoretical perspectives into agreement. Moreover, although the participants had learned to be skeptical about the impression of 'completeness' that is conveyed by traditional bibliographies and literary histories, they nevertheless expected the database to provide a body of reliable knowledge that could be used as a basis for monograph and journal publications. After all, they expected their involvement in the project to help them advance their disciplinary careers. Yet the collaborative model of the COST Action implied a very different relation between scholarly users and research technology. Rather than a readily usable source of knowledge, it required considerable labor input to curate and harmonize the data. The project leader tried to promote a view of the database as not simply the digital equivalent of traditional bibliography, but as a catalyst to stimulate new intellectual approaches which would not necessarily be organized around idiosyncratic monograph-narratives, albeit with limited success.

Equipping tools with better accessibility and participatory features, or designing them in a way that allows for the potential use of substantial datasets and computational power is thus not necessarily perceived as an enhancement by scholars. Instead, insofar as new features are often incongruent with established organizational models of scholarly work, their dedicated use may actually amount to what Bowker & Star (2000) call a breakdown of infrastructure. The digitized bibliography of Dutch Studies for example could be seen as an always up to date, easily accessible database with Web 2.0 functionality. Instead, some established scholars saw it as a detriment for their work, since it failed to provide the reliability and representational function their research depended on. Similarly, the digital database used in the COST Action initially seemed to offer a way of creating exciting empirical insights about forgotten women writers that were impossible to achieve by any single scholar. Quickly, however, participation in the project also began to appear as a risk for individual career development, insofar as the database required a way of organizing scholarly practice very different from the single-author, monograph-oriented model the participants normally operated with. Both case studies thus emphasize that the effective value of individual tools will not so much depend on hypothetical capabilities or abstract epistemological benefits, but rather on the extent to which they can be meaningfully integrated into the scholarly knowledge machine without jamming or producing too much friction. Initiatives that simply ignore this aspect, perhaps carried away by promises

made to create momentum for a given project, or to legitimize predetermined policy decisions, risk a backlash later on. This should not be mistaken for unqualified conservatism or a willful resistance to new technology on the part of the humanities (cf. ACLS, 2006; Wouters, 2007). While the slowly developing configuration of academic practices, as reproduced through undergraduate training and disciplinary reward systems, often appears as a deplorable inflexibility from the vantage point of technological innovators, it also guarantees that new scholarly work meaningfully connects to the extant body of knowledge, for example in terms of recognizable output format, shared tacit knowledge, as well as reliability of empirical sources. The best response to such infrastructural inertia, I suggest, is to address it upfront and without framing it as either inherently positive or negative. This may also constitute a first step in solving potential conflicts between technological affordances and scholarly practice, an aspect that I will elaborate later on.

The academic labor ecology is characterized by numerous interdependencies between distinct task areas. Such distinctions are instrumental in regulating their interaction, because they determine which group of actors needs which skills so as to accomplish its systemic function. An example is the division of labor between research proper and the work of information professionals, such as librarians and archivists. The latter order information according to established categories, thus providing scholars with bibliographical tools (archives, collections, library catalogues...) that can be readily used for producing new knowledge contributions according to disciplinary conventions. The move to digital scholarship, however, is related to shifts in such interdependent relations, with potentially significant effects on the intellectual substance of research. My second research question has therefore been: *How do actors in digital scholarship construct forms of labor as 'scholarly', 'technical', or 'support activities', and how does the distribution of labor make possible certain forms of knowledge, but not others?* In the case of the digitized bibliography of Dutch Studies, a key point of contention was the decision of reducing the editorial team and instead introduce a feature that allows users to individually add publications. This design choice transferred responsibility for bibliographical work from professional documentalists to the scholars who normally rely on the BNLT as a trustworthy, ready-made index of disciplinary knowledge. The ensuing controversy focused inter alia on how the task of guaranteeing the reliability of the bibliography should be distributed – should it be something that the Royal Academy takes responsibility for, or can it legitimately be seen to overlap with the core tasks

of scholars working at universities? To the many critics of the digitization, the incorporation of Web 2.0 features became synonymous with an official acknowledgement that the Royal Academy no longer considered the curation of national cultural heritage as one of its primary responsibilities.

The case of the COST Action further illustrates the intellectual implications of such issues. A core obstacle encountered by the participants was the need to contribute significant amounts of work to enter information into the database, as well as double-check and harmonize the growing dataset. Such work was necessary before participants could start making large-scale, comparative empirical knowledge claims about forgotten women writers. As I have argued, this obstacle presented itself as a recursive resource problem to the project leader: to make the project more attractive to the participants and secure follow-up funding, it was necessary to offer access to as much reliable data as possible, but in order to do so, a significant expense of human effort was required. However, many participants – usually employed as professors or faculty at university departments – tended to consider data work a subordinate technical activity, similar to bibliographic work, that distracted them from their many 'actual' tasks such as research and managerial responsibilities. The definition of data work as a non-intellectual activity was also a common argument to justify its delegation to student assistants, who were for example encouraged to combine their MA or PhD research with data curation in the project. But in contrast to bibliographic work and the monograph-oriented research model it enables, skills and intellectual principles for data-driven historical research are not very far developed among scholars. The only way to establish them is through actually experimenting with databases, algorithmic approaches and visualization tools in a comprehensive way, i.e. delve into the nitty-gritty of their functionalities and limitations. If the step of doing seemingly subordinate data work is delegated, scholars foreclose an opportunity to embed new technology in their research practices and perhaps work towards new conceptual approaches. The COST Action indeed wrestled with a problem of unequally distributed knowledge until its very end. While several student assistants developed meaningful research questions through getting their hands dirty in data work, most of the academically more advanced participants had not achieved such embedding even a few years into the project.

A first conclusion to be drawn from this, casually put, is that big data needs big data work. This aspect is often underestimated in the current hype surrounding the few actually well-funded digitization projects such as

Google Books. Also aside from digitization of sources proper, and in case data are openly available, a significant amount of work is typically necessary to make data compatible, both technically, conceptually, and in terms of their reliability. If this aspect continues to be absent from portrayals of future benefits of digital scholarship, it may result in a certain disappointment on the part of both funders and practitioners. A second conclusion is that the designation of activities necessary to make data usable as either a 'proper' intellectual task or a subordinate technical one is itself often used in a tactical way by actors. Scholars can refer to some kinds of work as technical because it is very different from the kind of activity they are normally rewarded for, and policy makers in turn can refer to data work as scholarly in order to justify reduction of public expenditure. Such dynamics are particularly consequential insofar as the construction of certain forms of labor is directly connected to reproducing or challenging the basic research skills and conceptual deep structure of dominant scholarly paradigms. The bibliographical categories that order the production of documents in literature, public life, and science are considered a subordinate technicality because they are widely accepted. There are many alternative or complementary possibilities for ordering written production that we still have difficulty to imagine, however, simply because the infrastructural conditions to develop them in a concerted fashion are not in place.

These findings, I would argue, warrant reframing the key question in current debates about the scholarly use of data-intensive research methods. At the moment, the question is often formulated like this: how will our understanding of art, history, and social life change if we harness much greater amounts of empirical information than was common in the past? The problem with this formulation is that it locates intellectual agency primarily in the act of analyzing data, and that it downplays the many forms of activity necessary to reproduce disciplinary methods and make data usable. My findings suggest that it would be desirable to rephrase the question: how does our understanding of art, history, and social life change if we begin to *begin to prepare* large amounts of data for interrogation? Such a formulation has a double advantage. It firstly draws attention the conceptual choices made by otherwise invisible data workers, and it emphasizes the effort necessary to mutually adapt scholarly practice and data to each other. Secondly, it encourages a realistic assessment of the investment required to make actual scholarly use of big data, rather than picturing it as an essentially free, added value that somehow arises from 'informatization'.

In summarizing my findings so far, I have emphasized how

infrastructural constraints affect the shaping of new tools, but I have not yet explicitly elaborated the extent to which these are distinctly disciplinary phenomena. Such knowledge is critical because it would give us a sense of the tailoring required to adapt digital tools and infrastructure to the needs of specific domains, and also of how such tailoring could proceed. As a third research question I have asked: *What role does disciplinarity play in the shaping of digital research tools, and how does the use of these tools affect disciplinarity?* Again, the case of the digitized BNTL can serve as a first illustration of what is at stake. The reduction of coverage that accompanied the transformation of the bibliography into an online database concerned, on the one hand, monographs in Dutch literary studies and literary history, i.e. scholarly contributions typically written in the national language and about topics primarily relevant to specialists of Dutch and Flemish literary history, which are not elsewhere indexed in a comprehensive fashion. Moreover, the initial digitization plan meant to completely exclude journals in modern Dutch linguistics, because they are already relatively well covered in other, international, databases. The subsequent discussions show that scholars consistently perceived the digitization to reflect strategic managerial choices about how to position the field of Dutch Studies internationally – critics associated the transformation of the bibliography into a database with reduced coverage and less funds as a testament that the Academy no longer considers the conservation and mediation of knowledge about Dutch and Flemish literature an important scholarly task, and defenders argued that Dutch Studies have to look for a different, more linguistically (and less hermeneutically) oriented international audience anyway.

Chapter 2 shows how the disciplinary configuration of literary history, characterized by low degrees of intellectual and social integration, poses specific obstacles for the originally envisioned usage of the database in the COST Action. Literary historians normally have relatively large leeway in framing their particular research objects, and they can choose a theoretical framework out of a range of coexisting options. This in turn made it very difficult to reconcile differences across individual practices in the framework of the project, even though there was a strong agreement on the basic research goal, as well as shared assumptions such as distrust regarding traditional bibliographies and historical accounts. Integrating individual practices in fact required participants to reach temporary consensus on how to define complex concepts such as genre and reception – theoretical problems that are normally subject to continuous debate among scholars in literary history. In the context of the project, however, these had to be

translated into pragmatic matters for the sake of advancing the collaborative undertaking. A particularly interesting development was the fact that project work could be more easily reconciled with individual career logic in the cases of smaller sub-projects, for example an initiative by a group of Serbian scholars loosely affiliated to the COST Action. The smaller number of participants and a more circumscribed empirical focus made it easier to agree on theoretical assumptions, as well as keeping the sheer amount of data work to a manageable level. This again reduced the need for a strict division of labor between professors and data workers, thus creating more favorable conditions for digital skill dissemination.

Disciplinarity also proved an important constraint in the collaborative project investigated in Chapter 3. Here, a small group of indonesianists, network researchers, and computer scientists tried to harness quantitative analysis of digitized newspaper corpora to better understand shifts in Indonesian elite networks. A key point of contention was the problematic original assumption that the open-ended hermeneutic research problems of the indonesianists (e.g., who and what are social elites, and how do they exert power over other groups?) could be 'solved' by a network analysis of elite actors based on their co-occurrence in newspaper articles. This suited an initially assumed division of labor between the participants, according to which computer scientists were positioned as the producers and conceptual definers of the data, while the humanities scholars were charged with interpreting them. The rationale for this arrangement was to ensure that all participants could contribute to the project but still get something out of it that would advance their individual careers. The proposed collaborative structure, however, turned out to pose a problem for the indonesianists, since disciplinary peers found such a reformulation of hermeneutic questions as an empirical problem for network analysis less than compelling when measured against the conceptual sophistication of dominant disciplinary theorizing. Therefore, the project began to experiment with alternative arrangements in which certain practices did not simply colonize others by imposing their respective assumptions – for example by presupposing that the concept of data current in network research and computer science can simply be transposed onto Indonesian Studies. Rather than using a specific type of quantitative analysis as the ultimate epistemic arbiter, the new goal was to develop an interdisciplinary division of labor in which multiple conceptualizations of the research object of elites could coexist.

Summarizing these results, it is fair to say that early or first time

efforts in digital scholarship are frequently characterized by a conflict between disciplinary expectations towards what a 'proper' knowledge contribution must look like (for example regarding methods, theoretical orientation, or output format) and the initially proposed use of a particular research tool. Digital project frameworks challenge the control over allocation of resources wielded by disciplinary authorities, thus buying the participants a degree of freedom to experiment with approaches deemed unconventional in their field. If they find ways of attracting a steady amount of funding, it is possible that such unconventional practices develop and persist, perhaps cutting ties with the original discipline altogether. Frequently, however, scholars will not be willing to give up their affiliation to traditional disciplinary contexts. In such cases, conflicts between digital affordances and domain-specific expectations can be productive if participants are able and willing to tackle certain ideological, technical, or economic constraints, for example the belief that digital scholarship *should* be about translating 'messy' hermeneutic problems into 'exact' empirical ones, or the fact that some data formats are easier to handle because they are widely accepted. An important strategy is also the adjustment of organizational and funding modalities. Small-scale projects for example can create a relatively circumscribed context for experimenting with novel research tools (i.e., manageable amounts of data work, not too much divergence of theoretical viewpoints among participants), thus creating a niche in which digital practices are easier to reconcile with disciplinary conventions than in larger-scale undertakings. An important general conclusion for future practitioners and policy makers is that the development of digital approaches is best conceptualized as a situated activity – rather than resulting from the implementation of rigid technical or collaborative designs, perhaps conceived by individuals outside the actual projects, viable arrangements are more likely to emerge through practice and over time.

While much of the above research highlights the important role of disciplinary, praxeological, and economic factors in shaping the digital humanities, this does not mean that the configuration of new scholarly practices is merely the mechanical result of intersecting constraints. The way digital scholars tackle conflicts when trying to bring unconventional research to closure is often characterized by deliberate agency, i.e. choices in favor of certain solutions and against others. This dynamics is an important analytical object not only because it shows how actors actively shape emerging technology, but also because it may itself contribute to reshaping

infrastructural constraints over time. I have asked as a fourth research question: *What is the reflexive agency of scholars in the embedding of new tools into their infrastructural work setting?* As suggested in the above, a process of reflexive adaptation was critical to developing a workable division of labor in the early phase of the Elite Network Shifts project. The original collaborative arrangement, according to which a co-occurrence-based dataset created by the computer scientists and network researchers should serve as the basis for 'solving' the hermeneutic problems of the indonesianists led to considerable theoretical criticism by scholars in the community of Asian Studies. The participants subsequently initiated a reflexive discourse, aided by myself as an STS analyst, in which the conceptual and practical ramifications of certain foundational assumptions (e.g., that data is a discipline-agnostic phenomenon) were questioned. While not magically making tensions disappear, this did open up the possibility to imagine alternative collaborative modalities that may well provide a model for how the participants will tackle similar problems in potential follow-up projects.

In Chapter 4, I have focused on the strikingly reflexive style that characterizes many publications circulated by digital scholars, both traditional peer-reviewed ones as well as digital formats. These publications draw attention to the practical conditions under which digital scholarship is conducted, typically by combining research arguments with a discussion of the tensions encountered in an academic environment that favors single-author, monograph-oriented scholarship. I have argued that by making visible aspects of practice that are not routinely addressed in formal scholarly communication, discursive reflexivity selectively 'unties' the standardized packages that together constitute the hinterlands of the humanities. For example, one set of documents grants a look behind the scenes of digital project work to provide practical advice for new entrants (THATCampCHNM, 2011). Topics include strategies for lobbying with funding bodies and partner institutions, but also management techniques for collaborative interdisciplinary work. Frequently, such advice includes a polemical critique of outdated humanistic curricula and inflexible institutional structures (Scheinfeldt, 2011), thus putting up for discussion the basic skills that scholars must possess in the early 21st century. Others again argue that such calls for digital humanists to be more 'realistic' about modern academic life encourages a pragmatic, managerial self-perception that is at odds with the critical function and hermeneutic sensibility of the humanities (Chun, 2013). More specifically, a number of practitioners

(Drucker, 2009; Hansen, 2012) problematize how digital project work is streamlined through reliance on standardized data formats. While useful to facilitate data sharing and reduce the complexity of project work, this tends to reify foundational conceptual assumptions about particular research objects, as well as making scholars dependent on often commercial software products. Ultimately, this form of reflexivity encourages a rather fundamental debate about the function of empirical arguments in digital scholarship, and the extent to which practitioners should sacrifice critical intentions in order to 'get stuff done'.

These empirical results affirm that it is not adequate to think of the development of digital scholarship simply as a diffusion of inherently defined tools into existing research practices, as the more hyperbolic accounts of a digital revolution would have it. Instead, digital scholarship develops through the creative uptake and adaptation of technological possibilities. When practitioners design and use new instruments, they make choices that constitute specific reactions to perceived infrastructural constraints. Individual solutions may in turn crystallize into new conventions for how to conduct digitally mediated research in the future – for example, new standards for how to conceptualize and exchange data, or widely used 'best practices' for dividing labor between collaborators from different disciplines. Reflexivity thus plays a key role in the evolutionary development of the scholarly infrastructure. At the same time, it is important to appreciate the function of human agency in this process. As I have shown, individual speakers propose different ways of framing and resolving tensions, and sometimes these are mutually exclusive. Discursive reflexivity in the digital humanities is consequently also a site of political controversy, where distinct ideas about how to reorganize the scholarly knowledge machine clash.

Most of the findings I have presented so far empirically focus on the level of specific scholarly practices or projects. However, this sidesteps how the economic, organizational, and political conditions for individual projects may themselves be shaped by longer-term, strategic initiatives to create digital infrastructure, which after all constitute an important reason for the current policy interest in digital humanities. My fifth research question is meant to shed light on this interaction from a comparative perspective: *How is infrastructure conceptualized differently across countries, and what role do such conceptualizations play in organizing infrastructure development 'on the ground'?* In my last chapter, I have argued that current infrastructure initiatives reconfigure the organization of disciplinary tool development, thus affecting

also the methodological structure of digitally mediated scholarship in the long run. In traditional modes of research, choices about tool development were largely reserved for disciplinary authorities (Whitley, 2000). Many national science systems, however, have recently entered a process of reconfiguration that challenges the mechanisms of disciplinary self-governance (Nowotny, Scott & Gibbons, 2001; Etzkowitz & Leydesdorff, 2000; Whitley, 2010). Current infrastructure initiatives illustrate this development in that they are based on strategic alliances between policy makers, funders, and researchers. Pursuing often heterogeneous interests, they are nevertheless held together by shared visions of future digital infrastructure. The infrastructure discourse, I have therefore argued, can be seen as an interface between research and policy in a historical period in which their relations have become newly volatile. Insofar as different definitions of networked digital instrumentation also imply specific ways of funding and coordinating tool development, it becomes of strategic importance for individual actors to promote a technological vision that suits their respective priorities.

In Europe, an important actor in infrastructure policy is the European Strategy Forum for Research Infrastructures (ESFRI), a supranational body constituted through an agreement of the European Council of Ministers and the European Commission in 2002. ESFRI stresses the need for centralized coordination of individual development activities, an approach that resonates with the longstanding policy goal to overcome the fragmentation of European research into national science systems. The various projects administrated by ESFRI are grounded in previous, nationally based efforts in humanities computing, but in order to ensure continued funding and political support, they now have to translate their activities into terms compatible with the European Commission's policy agenda. Participating initiatives have to present strategies for limiting the diversity of scholarly approaches supported through digital tools, so as to demonstrate commitment to the overarching goal of de-fragmentation. At the same time, ESFRI pictures infrastructure as something that can be developed in a series of clearly circumscribed projects, i.e. in an organizational context that is principally detached from the primary research process of the prospective users. This approach inevitably produces a certain disconnect between tool developers and the large majority of scholars who are unfamiliar with digital approaches. On the other hand, the emphasis on central coordination also ensures that no single disciplinary community gains exclusive control over technology development. The

situation in the US is different from the European context insofar as there has historically been a larger diversity of different funding sources, public, private, and philanthropic. Although these grant relatively small sums individually, such diversity has made digital humanities centers somewhat independent from the mandate of any single funding body, thus conferring them also a certain intellectual freedom. US digital scholars have rather successfully tried to protect and extend this independence by promoting an explicitly STS-informed definition of infrastructure, which stresses praxeological embedding of tools and the emergent character of technological development. Infrastructure here is not conceptualized as a specific technological artifact to be created in a singular project, but as the skills, tools, and facilities that gradually emerge from ongoing scholarship in digital humanities centers. While avoiding tensions related to the implementation of new tools in more traditional scholarly practices, this arrangement can be criticized for privileging the intellectual and technological choices of existing elites within digital humanities over that of other research communities.

The development of digital infrastructure can thus be seen as a particular example of the reflexive dynamics discussed under the previous heading. Rather than a neutral enhancement of scholarly practice, actors promote definitions of infrastructure informed by normative assumptions about science as well as strategic interests, for example the notion of a highly integrated European Research Area, or that of a network of relatively autonomous digital humanities centers. Once instantiated in funding frameworks and coordination mechanisms, these visions create specific conditions for local efforts in digital scholarship, thus reshaping existing organizational structures of research in their image.

Theoretical and practical implications

Scholarship, then, is in a flux, occasioned by a combination of widely available digital tools and facilities, a public discourse about the possibilities of digital scholarship, and concomitant investments in infrastructure. The contribution of this thesis has been to intersect these developments with a theoretically informed view of how the humanities have developed socially and intellectually into their present configuration. My conceptual influences, derived from various theoretical currents within STS, replace a commonsensical view of infrastructure and tools as characterized by inherent qualities with a socio-technical one, in which technology cannot be

thought of separately from the historically developed work routines in which it is embedded. Local activities always build on an 'installed base', i.e. a more slowly developing foundation of practices and institutional structures that I have characterized in more detail by drawing on Whitley (2000) and Law (2004). Against this background, the recently popular notion of a scientific revolution induced by big data appears to rely on questionable assumptions. More data/more computational power/more collaboration does not straightforwardly result in more or better knowledge, but also in more fragmentation and new conflicts between the status quo and digital affordances. Information, when drawn from different contexts, is unlikely to simply add up to a coherent empirical picture, and trying to enforce an unqualified notion of digital collaboration in a project may actually result in undermining existing collaborative structures. I would venture the following generalized conclusion: given the plurality of theory and methods in the humanities, initiatives that combine ambitious collaborative scale with ambitious praxeological changes will face particular challenges. The changes in practice they demand force a sizeable number of practitioners into opposition to the disciplinary status quo, thus cutting not only certain epistemic ties that depend on compatibility of infrastructural task areas, but also social ties to peer audiences and disciplinary funding and career possibilities. Put differently, the relatively weak degree of intellectual and social integration in the humanities means that practices are overall less standardized than in most natural sciences, thus making it more difficult to identify a substantial group of researchers that can agree on black-boxing certain sequences through a radically new piece of technology or a new organizational format.

To highlight the effort necessary to articulate disparate practices and technological affordances in such a pluralistic field I have used the metaphor of the humanities as a complex, knowledge-generating machine. This image draws attention to the need for reflexive attention to disciplinary history and situatedness when developing its internal mechanics, so as to ensure that engaging in digital scholarship does not create unmanageable friction with the installed base. This can for example mean to make the function of such a fundamental epistemological concept as data a topic for discussion in a project, and to change the role data are given in a collaborative workflow. Reflexivity can also mean rethinking the organizational modalities and goals of a project. For example, downscaling the epistemic scope and sheer number of collaborators in a given project will make it easier to reconcile conflicting demands on scholarly work hours and to reach agreements on

analytical goals. However, even if we acknowledge the need for applied reflexivity in a period of major socio-material reconfiguration, we should be aware that reflexivity can never be neutral. Local solutions to friction may in their own right crystallize into a new status quo over time, thus reshaping the installed base also for other actors.

In the coming years, we are likely to see numerous proposals for solving conflicts and developing the material and social environment of scholarly inquiry, and some of them will become part of the disciplinary hinterlands of future generations. While the exact ways in which such reconfiguration will occur are a problem for further empirical study, my findings do allow to summarize a few critical spots in the scholarly knowledge machine that are bound to play a particularly important role in the process. These can perhaps be imagined as clutches that transmit momentum between moving parts, thus making them privileged points for intervention. The first aspect is the conceptualization and distribution of different forms of labor in the scholarly work process, which I have argued to be instrumental in reproducing the basic conceptual structure and methodological foundation of a field. The reason why it is currently difficult to combine digital scholarly approaches with more traditional ones is a structural conflict between contradicting incentives: the specific acts entailed by digital scholarship are not part of disciplinary training and look too different from what is necessary to advance a traditional academic career. It is possible, however, that the increasing availability of digital tools, combined with ambitious outreach activities and general dissemination of digital skills through other channels, will further reduce that effort that individual scholars have to make to acquire basic skills in the use of databases, data work, and coding. Change in the notion of what constitutes proper intellectual work may be additionally stimulated as younger generations of researchers enter the professoriate. A more negative scenario is equally imaginable, however, in which the increasingly casualized employment of younger academics further reinforce the hierarchical distinction of 'technical' and 'intellectual' activities. Precisely because employment in dedicated research positions is becoming scarcer, the skill set and credentials necessary to achieve it could become even more specialized (cf. Whitley, 2010).

Second, the notion of authorship, which is a critical element in the knowledge machine because it mediates between disciplinary reputation dynamics, employment, and the scholarly publishing industry. Authorship selectively makes visible certain contributions while excluding others - in the

humanities, it has traditionally been equated with publishing monographs. At the same time, conventional definitions of authorship are being challenged through both formal university policies and emerging research practices. According to its 2008 PhD regulations, Leiden University (2008) for example principally accepts PhD dissertations jointly submitted by up to three authors, under the condition that individual contributions are demonstrable and significant. This is arguably the institutional response to the predominance of multi-authored papers in the natural sciences, which thereby become a formal possibility also in the humanities and social sciences. Another emerging trend is a broadening of the notion of authorship to encompass output that is not documents. In many quantitative fields like network research or scientometrics, it has become relatively common to cite technological instruments that bear a particular mark of individual creativity, such as algorithms or specialized software. Complementary developments in digital scholarship are the proliferation of journals that publish digital artifacts.⁵⁸ Again, however, we can observe a contradictory trend that has to do with the increasing scarcity of employment in disciplinary institutions. Many prestigious, competitive grant schemes on a national and European level continue to be centered on individual (rather than collaborative) research performance, and application modalities frequently seem to favor single-authored publications in journals or as monographs.

Third, increasing use of digital tools is related to changes in what we could call scholarly transparency practices. STS scholars (Latour & Woolgar, 1979; Knorr Cetina, 1981; Law, 2004) have often pointed out that modern scientific authority partly rests on the convention of deleting the messiness and contingency of the underlying work, i.e. the failed experiments, negotiation and power play among scientists, the effort necessary to translate instrument readings into authoritative statements etc. Traditional laboratory-based science provides specific conditions for accomplishing such purification (Latour, 1993). Most importantly, it takes place in a confined physical space that is accessible only to certified members of an expert community. Digital scholarship, by contrast, leaves more visible traces of the research process, for example through the use of social media, metadata created by tools such as Mendeley, or through applications that take part of the research and publishing process online (e.g., open peer review platforms such as mediaCommons). Such practices have a host of

58 Examples include *Vectors* and the *Journal of Digital Humanities*

advantages. To name but a few, they allow for near real-time discussion between authors and readers of digital publications, and they contribute to disseminating practical knowledge on how to do digital scholarship also among traditionally trained academics. Yet we should not assume that they make research 'visible' in any uncomplicated sense - actors will instead develop new strategies of selectively showing some aspects of their work but not others. This may in turn shape conventions of articulation work for future generations, for example by setting up new informal requirements for presenting stylized images of an unfolding research process in a perpetually uncertain, grant-based funding system.

Fourth, many public science systems have been experimenting with formal research evaluation mechanisms for some time now, since these seem to provide a straightforward way of steering research activities in particular directions (Whitley, Gläser & Engwall, 2010). A particularly pertinent, recent development is the attempt to tailor evaluation modalities to the diverse functions of science and scholarship, such as engagement with non-academic audiences, and the development of reusable software, databases, and other forms of digital output (American Academy of Arts & Sciences, 2014; ESF, 2011). However, expectations towards evaluation as a research policy tool are often based on insufficiently complex understandings of the relevant underlying dynamics. The British Research Assessment Exercise, one of the most radical examples of a regulatory intervention into disciplinary self-governance, was set up to ensure performance-based resource allocation, but also diversity and equality in research. Effectively, it has resulted in concentrating resources in a few elite institutions, the demotion of teaching as a task of universities, and the emergence of a transfer market for highly cited academics (Martin & Whitley, 2010; Mirowski & Sent, 2008). While it is very hard to predict how exactly current attempts at reforming research evaluation will interfere with disciplinary dynamics in the near future, it seems evident that they will have implications also for the further development of digital humanities.

Lastly, the adoption of digital approaches in the humanities will continue to be affected by new funding structures and ongoing development of digital infrastructure. A historically important way of tackling the incongruence between digital approaches and an academic environment configured for more traditional forms of research has been the establishment of centers for digital or interdisciplinary scholarship, i.e. organizational formats that exist partially outside the disciplinary landscape (Unsworth, 2007; Clement & Reside, 2011). Creating and sustaining such institutions

becomes easier as the primarily disciplinary control over academic employment is challenged by funding opportunities specifically meant to encourage digital scholarship (see for example Williford & Henry, 2012; BMBF, 2013). Concerted efforts to create digital infrastructure fulfill a similar function. Respective initiatives in Europe and the US come with specific strategies for coordinating and funding tool development, thus interfering with the disciplinary logic that used to inform choices about research instrumentation. I have suggested that especially ambitious infrastructure projects that aim to cover a large variety of approaches will generate friction due to the divergence of local practices and the intended use of individual tools. Nevertheless, given enough time and funding, they may still manage to link up with institutional reproduction of scholarly methods over time, for example if certain applications attract enough disciplinary attention to be incorporated in undergraduate methodology classes.

All of these aspects warrant broadly inclusive discussion. The latter two, evaluation on the one hand, and funding and development of infrastructure on the other, raise the additional question of participation in formal decision making processes. However, the design of research evaluation protocols on a national or university level is usually not put up for debate on a wider basis, almost as if the notion of excellence in science and (digital) scholarship were self-explanatory. Similarly, current infrastructure visions are usually presented as inherently desirable, with little explicit deliberation of underlying normative choices. Many European decision makers see digital infrastructure as a means to effectuate an integration of national science systems. In the US on the other hand, control over tool development is primarily located at established digital humanities centers, thus privileging the design choices of reputed digital scholars. Largely absent from the discourse is the majority of traditional humanists who are the prospective main users of the new technology. This is not to suggest that a scenario is possible in which all affected parties will be equally happy with the resulting infrastructure plans, and even the most democratically developed strategy may result in unintended effects (cf. Jensen & Winthereik, 2013). Nevertheless, taking inspiration from anticipatory governance models, as for example applied in nanotechnology (Barben et al., 2008), could be useful for working towards a more inclusive arrangement in which prospective beneficiaries of infrastructure are consulted before actual development activities are initiated.

While questions of participation and distributional justice are regularly addressed in STS discussions of infrastructure development

(Edwards et al., 2013), there is typically little attention for how they relate to the specificity and function of humanities knowledge in society. Few observers would disagree that it is desirable for, say, cancer research to be highly integrated intellectually and socially, so as to concentrate investment on a few promising lines of very resource-intensive inquiry. Whether such integration is desirable in the humanities is not so clear. Scholarly knowledge is characterized by and thrives upon the diversity of coexisting intellectual views, and it would not be difficult to argue that such diversity increases the import of the humanities for the rest of society. To what extent should evaluation modalities and longer term investment in digital scholarship be characterized by mechanisms that ensure plurality? This question is worth raising in the context of a possible model of anticipatory governance, since a frequently taken-for-granted design principle of infrastructure is an implicit, unqualified notion of efficiency. While some aspects of infrastructure can and should indeed be designed with efficiency considerations in mind, in other respects, for example methodology and theoretical orientation, such a rationale could result in undermining characteristic virtues of the humanities.

Directions for further research

A first way of further developing the above findings would be to expand significantly the conceptual and empirical scope of some of my original research questions. An important topic that I have only begun to touch is the relation between digitally mediated scholarship in specific projects and the shaping of such project work by policy and funding practices. Current developments in digital humanities occur against the background of a profound reconfiguration of public science systems, popularly summarized in notions such as Mode 2 (Nowotny, Scott & Gibbons, 2001) and the Triple Helix (Etzkowitz & Leydesdorff, 2000). As I have variously shown in the above, grant-based, digital research projects can create niches within disciplinary employment structures. However, they also come with new constraints that scholars in turn will try to adapt to their individual intellectual and professional interests. In what sense is the resulting knowledge informed by these shifting economic conditions, and how do scholars react to reconfiguring relations with policy makers and funding bodies? Such research could provide valuable empirical input for rethinking the commonly applied, and somewhat simplistic, dichotomy of bottom-up and top-down actions in the organizational dynamics of science. The two

notions are usually taken to express a separation between contexts of science policy and the work going on on the scientific shop floor. Infrastructure research, however, suggests a much more complex interplay between the two levels (cf. Edwards et al., 2009; Hepsø, Monteiro & Rolland, 2009), thus raising the question as to why we should keep operating with a hierarchical metaphor. One of the reasons why it has persisted so long arguably is the historical convention of STS and Computer Supported Cooperative Work to engage in ethnographic work in laboratories and office-like settings. Opportunities for ethnographies of Political institutions (with a capital P) on the other hand simply have no disciplinary tradition, and are perhaps also harder to come by. Yet it is exactly the interaction of the two levels that would currently seem to be of particular analytical interest.

Increased empirical scope could also be useful for developing the research questions underlying Chapters 2 and 3, where I study how friction between epistemic perspectives is dealt with in two specific projects. In the humanities, many basic differences between paradigms and theories are never resolved, but instead create an ideally fruitful, intellectual tension. In her influential study of medical practices for the diagnosis and treatment of atherosclerosis, Mol (2002) observes a corresponding multiplicity of ways in which this disease is enacted in different parts of a hospital. Mol in fact argues that various techniques, for example surgical intervention to clear clogged-up arteries, or walking therapy aiming to improve blood flow through physical exercise, bring into being specific ontologies of atherosclerosis, which are interrelated but do not coincide. Friction between them is managed not least by distributing forms of enactment physically across different wards with distinct specializations. This parallels how multiplicity of perspectives is managed in the humanities – scholars can adopt diverging viewpoints on the 'same' object by using the individualistic format of the monograph and by operating in more or less contained national or regional intellectual contexts (often delimited as a language community). It is an open empirical question how the spread of networked research and publication practices, for example the use of databases and augmented journals, will affect the management of multiplicity on a larger scale. More fundamentally, an investigation along such lines would require probing the use of Mol's theoretical work for analyzing knowledge production in the humanities. Can scholarly research practices indeed be seen to enact ontologies? Do historians who write monographs actually create different realities than scholars who apply data-intensive analytical methods, or do they create different representations of the same objects? Is

such a general distinction between ontology and epistemology possible and useful to describe scholarly knowledge production (cf. Lynch, 2014; Aspers, 2014)?

Another fruitful direction for future research would be to intersect the perspective of infrastructure studies with the sociology of expectations. The latter has theorized expectations as future-oriented networks (Borup et al., 2006; van Lente, 2000), i.e. as creating protected niches in which actors can experiment with new practices. It would seem intuitive to integrate this perspective more systematically with the perspective of infrastructure studies, which tries to identify networks that have developed historically. A privileged empirical entry point for such a study could be the widely discussed topic of sustainability of digital applications and infrastructure (ESF, 2011; Berman et al., 2010). Sustainability here denotes strategies for ensuring the continuous accessibility and functioning of digital resources. In a sense, this constitutes a future-oriented complement to my argument about the need for preventing 'jamming' of the scholarly knowledge machine through reflexive adaptation. However, it is striking that sustainability is usually considered only in terms of appropriate funding strategies, data and software formats, as well as legal issues relating to intellectual property and data sharing policies (Berman et al., 2010; David, 2005; Lossau & Peters, 2008). While undoubtedly critical aspects, these discussions would seem to benefit from a historically minded perspective that theorizes sustainability also as a matter of reproducing practices, so as to keep knowledge intelligible and compatible across different historical periods. Put differently, we should expand our notion of obsolescence, which is typically framed as either a purely technical problem or an insidious market strategy, to encompass intellectual and epistemic obsolescence, i.e. the failure to meaningfully relate to historical frames of intellectual practice.

